

The Species of *Asaphes* Walker from America North of Mexico, with Remarks on Extralimital Distributions and Taxa (Hymenoptera: Chalcidoidea, Pteromalidae)

GARY A. P. GIBSON AND VELI VIKBERG

(GAPG) Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Centre, Biological Resources Program, K. W. Neatby Building, Ottawa, Ontario, Canada K1A 0C6;
(VV) Liinalammintie 11 as. 6, FIN-14200 Turenki, Finland

Abstract.—The species of *Asaphes* Walker (Pteromalidae: Asaphinae) are reviewed for the world and revised for America north of Mexico. Six species are recognized as valid in the region: *Asaphes brevipetiolatus* n. sp. (Canada, USA, Finland), *A. californicus* Girault, *A. hirsutus* n. sp. (Canada, USA, Mexico, Austria, Czech Republic, Finland, Greenland, Norway, Russia, Sweden), *A. petiolatus* Zetterstedt, *A. suspensus* (Nees), and *A. vulgaris* Walker. *Asaphes petiolatus* (revised status) is removed from synonymy under *A. vulgaris*. *Asaphes indicus* (Bhatnagar), described from India, is removed from synonymy under *A. vulgaris* and along with *A. rufipes* Brues, *A. lucens* (Provancher), *A. fletcheri* (Crawford), and *A. americanus* Girault is synonymized under *A. suspensus* (new synonymies). A lectotype is designated for *A. americanus*. *Asaphes huebriichi* (Brèthes) and *A. bonariensis* (Brèthes), described from Argentina and previously synonymized under *A. fletcheri* and *A. lucens*, respectively, are treated as *nomina inquirenda*. A key is given to distinguish males and females of the species in the region; diagnostic features are illustrated using scanning electron micrographs. Distribution and host data are summarized for each species in the Nearctic region, including records of *A. brevipetiolatus* parasitizing *Choristoneura fumiferana* (Clemens) (spruce budworm) and *Neodiprion abietis* (Harris) (balsam fir sawfly), likely as a hyperparasite. Remarks are also given on extralimital distributions of world species and generic composition of the subfamily, including the existence of an undescribed genus of Asaphinae in the Neotropical region, the likelihood of at least three undescribed species of *Asaphes* in regions other than the Nearctic, and the likelihood that most or all records of *A. suspensus* and *A. vulgaris* from the Neotropical region, and of *A. vulgaris* from at least the Afrotropical region of Africa, are misidentifications.

Species of *Asaphes* Walker are known from all continents except Antarctica and usually are considered to be exclusively hyperparasites of aphids. Graham (1969) revised the western European species and Kamijo and Takada (1973) revised the Japanese species. Two species were recognized from each area, *A. suspensus* (Nees) and *A. vulgaris* Walker from western Europe, and *A. suspensus* and *A. pubescens* Kamijo & Takada from Japan. Burks (1979) catalogued four species from America north of Mexico, *A. californicus* Girault, *A. lucens* (Provancher), *A. rufipes* Brues, and *A. vulgaris*, though Graham (1969) had previously suggested that *A. lucens*

might prove to be a synonym of *A. suspensus* and Peck (1951, 1963), Graham (1969), and Burks (1979) all questioned the presence of *A. vulgaris* in North America. The only other currently recognized valid name of *Asaphes* is *A. aphidi* (Risbec), which was described from Madagascar by Risbec (1959). Though Bouček (1976) clarified the generic placement of this species he stated that further study was required to determine whether it was a good species or a synonym of one of what was then thought to be two cosmopolitan species, *A. suspensus* and *A. vulgaris*. All other names described from other regions, including India and South America, were

synonymized under *A. suspensus* or *A. vulgaris*. The purpose of this study was to clarify the species composition and host relationships of *Asaphes* in America north of Mexico. To do so, other genera of Asaphinae and *Asaphes* from other regions were examined and this has resulted in remarks being included on extralimital distributions and taxa. The discovery that *A. petiolatus* was incorrectly synonymized under *A. vulgaris* and that other species in Europe, North America, and elsewhere exist that are similar to *A. vulgaris* or *A. suspensus* suggest that all currently accepted synonyms of these names should be re-examined.

Unlike in most pteromalids, males of most species of *Asaphes* are more readily identified to species than are females, particularly by differences in the antennal scape. Also important for differentiating species, in either sex, are setal pattern of the forewing (setation of basal cell and structure of speculum), presence or absence of setae on the metapleuron, sculpture of the frenalum, and color pattern of the legs. Although females of *A. brevipe-tiolatus* n. sp. are distinguished by head structure, females of all the other species can only be identified correctly by using combinations of the above features because of overlap in character states. Further, different species, or even opposite sexes of different species, can be collected or reared at the same place, time, and even from the same host. Consequently, it is easy to misidentify some specimens, particularly females or poorly preserved and mounted individuals.

MATERIALS AND METHODS

Terms and abbreviations used for structures follow Gibson (1997), with the following clarifications: 'scutellum' is used for that part of the scutellum anterior to the frenalum (Fig. 50); the 'disc' of the forewing is the entire membranous region beyond the basal setal line (Fig. 68); and the 'funicle' is composed of all flagellar seg-

ments basal to the club (Fig. 19), including the basal-most ring-like segment, which is designated as fu_1 (Figs. 19, 20). Head width is maximum width measured in dorsal view; head height is maximum height excluding the mandibles measured in lateral view; measurements of eye length and malar space are maximum lengths in lateral view with both endpoints equally in focus; petiole width is maximum width behind the anterior flange and petiole length is maximum length from the anterior flange to the abruptly declined posterior edge. In order to obtain the accurate measurements and observations of structure and sculpture necessary to correctly identify specimens, glare from incandescent light sources must be reduced by using fluorescent light or by placing some light-diffusing material, such as a piece of translucent tracing acetate, close to the specimen (see Goulet and Mason, 1993: 60). Color of the coxae is not included as part of the leg color pattern because the coxae can be yellowish or brownish in teneral specimens. However, color of the trochanter is important and sometimes differs from the trochantellus so that it is important that these two structures be differentiated.

Diagnoses of females and males are based on Nearctic specimens, with additional variability based on specimens from other regions included in brackets or discussed under 'Remarks'. The distribution listed and mapped for each species is based only on specimens examined, not literature records. Exact locality and other label and museum data are given only for the two newly described species and the two relatively uncommon species in North America, *A. petiolatus* and *A. vulgaris*. However, in order to facilitate future studies in other regions, all countries from which extralimital specimens were seen are listed under 'Distribution', along with acronyms of collections containing the specimens. Extralimital distributions listed for *A. petiolatus*, *A. suspensus*, and *A.*

vulgaris are not exhaustive because no attempt was made to examine collections extensively in other than the Nearctic region. Unless stated otherwise, listed specimens, including paratypes of the two new species, are in the CNCI. Acronyms for the museums from which material for this study was examined are listed in acknowledgments. Label collection data has been standardized to a single format, with any additional explanatory data given in brackets. Some records from Canada have an F.I.S. number, which refers to the Forest Insect Survey of the Canadian Forest Service; localities from Finland often have two sets of numbers separated by a colon, which is a uniform grid reference (Grid 27°E) explained in Heikinheimo and Raatikainen (1981). Locality records from Canada are listed by province from west to east and alphabetically by state for the USA. Locality records for Finland, Norway and Sweden are ordered by biological province listed south to north and west to east; abbreviations used on the labels for each province are included in brackets. The numerical codes included as part of the label data of specimens reared in Sweden by Gärdenfors are partly explained in Gärdenfors (1986: 21).

Aphidae (Homoptera) nomenclature is based on Eastop and Hille Ris Lambers (1976). Invalid combinations as given on labels of paratypic material are not italicized when given in association with the valid combination. Mackauer (1968) is used for nomenclature of Aphidiinae (Hymenoptera: Braconidae). The publications of A.A. Girault are numbered according to the bibliography of Dahms (1978).

Specimens for scanning electron microscopy (SEM) were prepared following Bolte (1996). The SEM micrograph negatives were scanned into a computer with a 35mm scanner, digitized, enhanced, and the final plates compiled and labelled using Adobe Photoshop[®]. Distribution maps were generated using Quickmap[™]. Only those localities whose position could

be determined unequivocally were mapped so that the maps generally are less comprehensive than the listed records.

ASAPHINAE

Pteromalidae, Miscogasterinae, Asaphini Ashmead 1904: 328; Peck 1951: 536; Peck 1963: 601; Peck et al. 1964: 36.

Pteromalidae, Asaphinae; Graham 1969: 77; Burks 1979: 785; De Santis 1979: 125; Dzhanokmen 1987: 112; Bouček 1988: 343.

Diagnosis.—Head with occipital carina (Figs. 13–17) and genal carina (Figs. 8, 10, 12); left mandible bidentate and right mandible tridentate (Fig. 18) (except *Ausasaphes*). Antenna inserted conspicuously below middle of face, dorsal margin of torulus slightly above to distinctly below lower orbit (Figs. 1, 3, 5, 7, 9, 11) (except *Ausasaphes*), 13-segmented with 1–3 basal flagellar segments ring-like and/or without longitudinal sensilla (Figs. 19–30). Pronotum in dorsal view transverse-rectangular and convexly rounded into neck (shape not evident in Figs. 43–48 because of view). Mesoscutum (Figs. 43–48) with complete, sulcate notauli; axillae not advanced anterior to base of scutellum. Forewing of fully winged individuals (some *Ausasaphes* brachypterous) with marginal and submarginal veins separated by very short hyaline region, with relatively long stigmal and postmarginal veins, and with marginal vein at most 2.4 times as long as stigmal vein. Metasoma with transverse to elongate, tubular, sculptured petiole (Figs. 43–48).

Asaphes Walker

Asaphes Walker 1834: 151. Type species: *Asaphes vulgaris* Walker; by monotypy.

Isocratus Förster 1856: 53, 58. Unjustified replacement name according to Gahan and Fagan 1923: 18; incorrectly considered as preoccupied by *Asaphus* Brongniart.

Notopodion Dahlbom 1857: 295. Type species: *Asaphes vulgaris* Walker; subsequently designated by Graham 1990: 200. Synonymy by Graham 1990: 200.

Parectroma Brèthes 1913: 91. Type species: *Parectroma huebrichi* Brèthes; by original designation. Synonymy by De Santis 1960: 113.

Diagnosis.—Body black or, more commonly, dark with obscure to bright metallic green luster on head and mesosoma. Head with broad, shallow scrobal depression occupying most of region between eyes and anterior ocellus, and smoothly rounded into parascrobal regions (Figs. 1–12). Clypeus distinctly delineated by sutures and at least slightly convex (Figs. 4, 6). Eye superficially bare or sparsely setose (Figs. 1–16). Flagellum (Figs. 19–42) with fu_1 ring-like; fu_2 ring-like to longer than wide but without longitudinal sensilla; fu_3 with longitudinal sensilla. Pronotum about half as long as mesoscutum (length not evident in Figs. 43–48 because of view), evenly setose and with very fine to distinct net-like engraved sculpture except along posterior margin. Mesoscutum (Figs. 43–48) setose and sculptured like pronotum except lateral lobes usually broadly bare and sometimes smooth medially; axillae widely separated; scutoscuteellar suture deeply sulcate along anterior margin of scutellum and for short distance along anteromedial margins of axillae (Figs. 43–48); scutellum bare at least posteromedially, with bare frenum delineated by variedly distinct transverse sulcus (Figs. 50, 52, 54); prepectus bare (Figs. 61, 63); mesopleuron with shiny, characteristically shaped femoral depression that includes abrupt or carinate anterior margin, deep transepisternal pit posteromedially, and arcuate transepisternal sulcus between pit and anterobasal edge of mesocoxa (Figs. 61, 63). Metanotum with three or more long, curved, paramedial setae directed toward median (Figs. 43–48); metapleuron with supracoxal flange and with two or more carinae at least on flange (Figs. 64–66); metacoxa conspicuously setose dorsobasally (Figs. 55–66). Propodeum coarsely, irregularly sculptured, without complete median carina though

often with variedly distinct, inverted Y-shaped carina, and with long white setae lateral to each spiracle (Figs. 43–48). Forewing with marginal vein relatively short, at most 0.3 length of submarginal vein, subequal in length or shorter than stigmal vein and shorter than postmarginal vein. Petiole at least two-thirds as long as propodeum, tubular but divided into dorsal and ventral parts by lateral sulcus (Figs. 63–66), dorsally reticulate and usually with irregular longitudinal carinae or stronger parallel keels (Figs. 43–48, 55–60), ventrally concave (Figs. 75, 76), and with anterior margin carinate (Figs. 43–48, 55–60). Gaster (Fig. 74) with terga low convex, non-collapsing, and mostly smooth and shiny, at most with very fine micropunctulate or coriaceous sculpture on Gt_3 – Gt_7 ; Gt_1 and Gt_2 occupying at least half length of metasoma; Gt_1 basally with at most 4 setae dorsolaterally near petiole (Figs. 43–48, 55–60); Gs_5 concave basolaterally for reception of posterolateral margin of petiole and with \wedge - or \cap -shaped, often longitudinally carinate, basomedian projection (Figs. 75, 77, 78).

Discussion.—Asaphinae was first established as the tribe Asaphini in the pteromalid subfamily Miscogasterinae by Ashmead (1904). The group has been recognized as a subfamily of Pteromalidae since Graham (1969). Graham (1969: 78) stated that "the group appears to me distinct enough to be regarded, at least provisionally, as a subfamily," but he did not list any features that he considered differential and simply keyed out assigned genera in three places in his key to pteromalid subfamilies. He classified three genera in Asaphinae, *Asaphes*, *Hyperimerus* Girault, and *Bairamlia* Waterston, and tentatively proposed that *Bairamlia* Waterston (1929) was a junior synonym of *Parasaphodes* Schulz (1906) (Graham 1969: 84). However, Bouček (1988) not only treated *Parasaphodes* as a valid genus, he established the new subfamily Parasaphodinae for it. Bouček (1988) also removed *Bairamlia*

from Asaphinae, stating (p. 343) that it "seems to have closer relation with the current Miscogasterinae," and assigned two additional genera to the subfamily, *Ausasaphes* Bouček and *Enoggera* Girault. In addition to keying out assigned genera in two places in his key to genera Bouček (1988: 343) listed several features that "seem to be of major importance" for the subfamily. In the course of this study we saw specimens (CNCI) of an undetermined number of species from Central and South America that appear to belong to a fifth, undescribed genus that should be classified in Asaphinae.

It is beyond the scope of this study to determine the validity or limits of the subfamily in Pteromalidae or to resolve the relationships of the genera currently assigned to Asaphinae. The diagnoses given above are based on examination of the four currently assigned genera and the undescribed genus from the Neotropical region. *Asaphes* is distinguished from the other four genera by one apparent autapomorphy, the presence of long, paramedial, medially-directed setae on the metanotum (Figs. 43–48, 55–60). Other Asaphinae have the metanotum bare.

Both *Ausasaphes* and *Enoggera* are restricted to Australia and can be identified using the key provided by Bouček (1988). *Hyperimerus* was previously thought to be Holarctic, but during the course of this study we saw two females of a new species from Guatemala (CNCI) that is similar to *H. corvus* Girault and a single female (CNCI) from Thailand that represents another new species. *Asaphes* is the most widely distributed genus, though it likely was introduced into Australia by man (Bouček 1988). The keys of Graham (1969), Bouček and Rasplus (1991), or Bouček and Heydon (1997) can be used to differentiate *Asaphes* from *Hyperimerus* and from other pteromalid genera, though features used in all three keys require slight clarification. Graham (1969: 78) was inaccurate in stating that the gena of *Hyperimerus* is not bordered

by a sharp carina. Also, the petiole of *Asaphes* is transverse in some species though certainly it is much longer and more conspicuous than that of *Hyperimerus* (see Graham 1969: 78 and Bouček and Rasplus 1991: 30). The differentiating couplet for *Asaphes* in Bouček and Heydon (1997: 567) has to be modified with the discovery that some species have a distinctly sculptured frenalum (Figs. 50, 52). *Asaphes* is further distinguished from *Hyperimerus* by having a setose metanotum (Figs. 43–60), the basal gastral tergum sparsely (Figs. 43–48, 55–60) rather than extensively setose near the petiole (Graham 1969), the prepectus bare (Figs. 61, 63) rather than setose, and the anterior margin of the femoral depression abruptly margined (Figs. 61, 63).

Species of what we consider to be the new Neotropical genus more closely resemble species of *Asaphes* than *Hyperimerus* because individuals have a long petiole and sparsely setose gaster. However, they are readily distinguished from species of *Asaphes* by a distinctly reticulate femoral depression, mostly smooth and shiny propodeum with a straight median carina, uniformly cylindrical and longitudinally carinate petiole, evenly convex and entirely or anteriorly longitudinally carinate first gastral sternum, and conspicuously setose eyes.

Biology.—Species of *Asaphes* have usually been considered to be hyperparasites of aphids (Homoptera: Aphididae), through the following primary parasites: Aphidiinae (Ichneumonoidea: Braconidae), Encyrtidae, and Aphelinidae (Chalcidoidea) (Hagen and van den Bosch 1968). However, there are a few published records of other Homoptera or predators of aphids as hosts. Lal (1934) reared a species identified as *A. vulgaris* from nymphs of the pear psylla, *Psylla pyricola* Förster (Homoptera: Psyllidae), in Scotland, and McMullen (1966) reared *A. suspensus* (misidentified as *A. vulgaris* in McMullen 1996, 1971, and in Philogene and Chang 1978)

from *P. pyricola* in British Columbia, Canada. In both instances the *Asaphes* likely was a hyperparasite because also reared were *Prionomitus mitratus* Dalman (Encyrtidae) and *Trechnites insidiosus* (Crawford) (Encyrtidae), respectively. Brown and Clark (1960) reared three females of *A. brevipetiolatus* (as *Asaphes* sp.) from a puparium of *Neocnemodon coxalis* (Curran) (Diptera: Syrphidae), a predator of the balsam woolly aphid, *Adelges piceae* (Ratzeburg), likely as a hyperparasite because four specimens of *Syrphophagus quadrimaculatus* (Ashmead) (Encyrtidae) were reared from the same puparium. We have seen additional specimens of *A. brevipetiolatus* whose labels and host remains indicate they were reared from syrphid larvae, as well as rearings from the spruce budworm, *Choristoneura fumiferana* (Clemens) (Lepidoptera: Tortricidae), and the balsam fir sawfly, *Neodiprion abietis* (Harris) (Hymenoptera: Diprionidae). One specimen reared from *C. fumiferana* had an unidentified braconid cocoon associated, indicating that *A. brevipetiolatus* is a hyperparasite of the spruce budworm. Multiple specimens of *A. brevipetiolatus* associated with some rearings indicate that it is or can be a gregarious parasite.

Species of *Asaphes* are ectoparasites and except for *A. brevipetiolatus* apparently almost always solitary hyperparasites. Usually they are secondary hyperparasites, ovipositing into mature larvae, prepupae or pupae of the aphidiine, encyrtid, or aphelinid primary parasite within the aphid mummy. The primary parasite is almost immediately paralysed by a venom as part of oviposition and further devel-

opment is prevented regardless of the stage attacked (Sullivan 1972, Keller and Sullivan 1976, Bocchino and Sullivan 1981). Studies have also shown that species can be tertiary hyperparasites if the primary parasite has already been parasitized by some other secondary parasite, such as by species of Megaspilidae (Hymenoptera: Ceraphronoidea) or Charipidae (Hymenoptera: Cynipoidea) (Griswold 1929, Sullivan 1972, Carew and Sullivan 1993), or by another *Asaphes* (Levine and Sullivan 1983). Sullivan (1972) also showed for *A. californicus*, and Keller and Sullivan (1976) for *A. suspensus* (as *A. lucens*), that females will make multiple attacks and drillings of the same aphid mummy and frequently deposit more than one egg, though in all cases only a single adult emerged. However, superparasitism and multiparasitism are possible though probably very rare because Carew and Sullivan (1993) reared two dwarf female *A. suspensus* (as *A. lucens*) from one aphid mummy, and a dwarf male together or with another secondary parasite from another mummy.

Host feeding was demonstrated for *A. californicus* by Sullivan (1972), for *A. suspensus* by Keller and Sullivan (1976), and for *A. vulgaris* by Le Ralec (1995). A feeding tube is constructed prior to oviposition. Once feeding is completed the ovipositor is reinserted, the feeding tube broken by the ovipositor, and an egg deposited (Keller and Sullivan 1976). Griswold (1929) described and illustrated the immature stages. Mating habits are described by Griswold (1929) and Sekhar (1958).

KEY TO SPECIES OF *ASAPHES* WALKER FROM AMERICA NORTH OF MEXICO

- | | | |
|------|---|---|
| 1 | Female | 2 |
| - | Male | 7 |
| 2(1) | Head in frontal view subquadrate with dorsal margin of torulus distinctly below lower orbit (Figs. 1, 2); malar space as long as width of eye or longer and at least 0.7 eye length (Figs. 1, 2); frenum with distinct net-like sculpture similar to that on scutellum (Figs. 49, 50, 55); forewing with very narrow speculum, the bare area closed basally | |

	by setae and with line or lines of setae immediately behind submarginal vein on disc (Fig. 73)	<i>Asaphes brevipetiolatus</i> n. sp.	
-	Head in frontal view transverse-subtriangular with dorsal margin of torulus about in line with lower orbit (Figs. 5-12); malar space at most about 0.8 width of eye and less than 0.65 eye length; frenum usually smooth and shiny except for longitudinal carinae near lateral margin (Figs. 56, 57, 59, 60); forewing sometimes with broad speculum and without setae near submarginal vein on disc (Figs. 68, 70)		3
3(2)	Frenum with distinct, uniform, engraved net-like sculpture similar to scutellum (Figs. 51, 52); metapleuron bare (Fig. 65); petiole at most as long as wide and usually slightly though obviously transverse (Fig. 51); legs with at least trochanters and all but extreme apices of femora dark (trochantelli rarely yellowish); forewing with speculum basally closed by setae and with line or lines of setae immediately behind submarginal vein on disc (Fig. 72)	<i>Asaphes petiolatus</i> Zetterstedt	
-	Frenum usually broadly smooth and shiny except for longitudinal carinae near lateral margins (Figs. 56, 59, 60), but if with obscure net-like sculpture paramedially and along posterior margin (Fig. 54) then metapleuron with at least some setae anteroventrally and often conspicuously setose (Figs. 61, 62); petiole usually at least slightly longer than wide except sometimes if metapleuron also setose (Figs. 44-48); legs usually entirely yellowish or at least with trochanters yellowish; forewing sometimes with broad, open speculum and without setae near submarginal vein on disc (Figs. 68, 70)		4
4(3)	Metapleuron with at least several setae anteroventrally and usually more extensively setose (Figs. 61, 62); legs with trochanters dark, concolorous with femora; forewing with speculum basally closed by setae and with line or lines of setae immediately behind submarginal vein on disc (Fig. 71)	<i>Asaphes hirsutus</i> n. sp.	
-	Metapleuron bare (Figs. 63-66) or at most with one or two short seta anteroventrally; legs usually with at least trochanters yellowish and often uniformly light colored, but if trochanters dark then speculum broad, open, and disc without setae near submarginal vein (Figs. 68, 70)		5
5(4)	Speculum distinct, broad basally and narrowed toward stigmal vein, without setae near submarginal vein and immediately beyond basal setal line at least as wide as distance between first and third setal lines on disc (Fig. 70); head in dorsal view distinctly concave between inner orbits (Fig. 15); hind leg with trochanter and femur (except often trochantellus and apex) infusate to black [east of Manitoba in Canada and northeastern seaboard states in USA]	<i>Asaphes vulgaris</i> Walker	
-	Speculum variedly distinct, most often with line of setae behind submarginal vein separated from vein by distance at most equal to distance to next setal line (Fig. 67), but sometimes with relatively broad speculum basally closed by one or more setae (Fig. 68); head in dorsal view shallowly concave between inner orbits (Fig. 16); hind leg uniformly yellowish or with trochanter and trochantellus usually yellowish (very rarely black) in contrast to infusate or black femur [transcontinental]		6
6(5)	Legs more or less uniformly light-colored, yellow; forewing always with several setae close to submarginal vein on disc, hence speculum very poorly developed (Fig. 69)	<i>Asaphes suspensus</i> Walker	
-	Legs with at least metafemur in part darker than light-colored metatrochanter unless metacoxa also light-colored, and then forewing with broad speculum except for one or two setae interrupting bare area (Fig. 68)	<i>Asaphes californicus</i> Girault	
7(1)	Antenna with scape and pedicel yellowish, contrasting distinctly with dark flagellum; scape with ventral margin sinuate, protuberant ventrobasally and tapered apically (Figs. 31, 32); head with dorsal margin of torulus distinctly below lower orbit (Figs. 3, 4)	<i>Asaphes brevipetiolatus</i> n. sp.	
-	Antenna more or less uniformly dark or with flagellum lighter in color; scape usually almost cylindrical or spindle-shaped (Figs. 34, 36, 38, 40, 42); head with dorsal margin of torulus almost in line with lower orbit (Figs. 5-12)		8

- 8(7) Outer surface of scape with variously elongate-oval or lanceolate microsetose sensory region (Figs. 33, 34a); legs usually with at least metafemur distinctly darker than metatrochanter unless metacoxa also yellowish-brown *Asaphes californicus* Girault
- Outer surface of scape without distinct setal patch, at most with linear setal band along ventral margin (Fig. 40a); legs varied in color, but often uniformly yellowish or with trochanters similarly dark as femora 9
- 9(8) Metapleuron with at least 3 setae in extreme anteroventral angle, and often much more extensively setose (Figs. 61, 62); forewing without distinct speculum, disc setose behind submarginal vein, the distance between vein and first setal line only slightly greater than distance between first and second setal lines; metafemur and metatrochanter usually dark; scape usually with slightly concave to flat ventral surface over at least apical two-thirds (Fig. 36a) *Asaphes hirsutus* n. sp.
- Metapleuron bare (Figs. 63–66); other features varied but usually either forewing with distinct speculum (Figs. 68, 70) or legs yellowish beyond coxae and scape without distinctly differentiated ventral surface 10
- 10(9) Forewing disc with broad speculum narrowed toward stigmal vein, but over most of length width of bare band about equal to distance from first to third setal lines on dorsal surface of disc (Fig. 70); basal cell with single line of setae behind submarginal vein except apically near basal setal line (Fig. 70); legs often with at least metafemur dark; frenum smooth and shiny (Fig. 60); petiole at least 1.25 times as long as wide (Figs. 59, 60) *Asaphes vulgaris* (Walker)
- Forewing disc with at least 3 setae on dorsal surface separated from submarginal vein by distance about equal to width of vein or by distance between first and second setal lines (Figs. 69, 72); basal cell with more than one line of setae behind submarginal vein over most of length and often more or less uniformly setose (Figs. 69, 72); legs usually entirely yellowish; frenum sometimes with fine sculpture (Figs. 52, 58); petiole sometimes less than 1.2 times as long as wide (Fig. 58) 11
- 11(10) Legs entirely yellowish beyond coxae; frenum smooth and shiny (Fig. 59); petiole usually at least 1.2 times as long as wide (Fig. 59) *Asaphes suspensus* (Nees)
- Legs with trochanters, trochantelli and most of femora dark²; frenum with fine sculpture at least paramedially (Fig. 58); petiole at most 1.15 times as long as wide (Fig. 58) *Asaphes petiolatus* Zetterstedt

¹ Females from western Europe sometimes with frenum quite broadly smooth with only very obscure sculpture.

² Some western European males with legs almost entirely yellow beyond coxae, see 'Recognition' for *A. petiolatus*.

Asaphes brevpetiolatus Gibson and Vikberg, new species

(Figs. 1–4, 13, 14, 19, 20, 31, 32, 43, 49, 50, 55, 64, 73)

Type material.—*Holotype*, female (CNCI, Type No. 22267): CANADA, New Brunswick, F'ton [Fredericton], em. June 23, 1966, R.C. Clark, AP.66-10-2, ex. Syrphidae. *Allotype*, male (CNCI): same data as holotype. *Paratypes*: CANADA, Yukon Territory: Ross River, 16.IV–31.VIII.84, S.&J. Peck, aspen willow river terrace (1 ♀, 2 ♂). British Columbia: Manning Provincial Park, 2 km N Blackwall Peak, 49°07'N 121°

45'W, 2000 m, 9.VII.86, H. Goulet, subalpine meadow (1 ♀). Alberta: Banff, 12.VIII.53, F.I.S. No. A803D, ex. syrphid, host prob. aphid (3 ♀, NFRC). Fort MacKay, 2.8 km N bridge, 2.IX.79, G.J. Hilchie & J. Ryan, mix-conifer forest (2 ♀). Jasper Gate, 2.III.51, F.I.S. No. A3125B, ex. syrphid, host prob. aphid (2 ♀, NFRC). Jasper National Park, Maligne Road, 7.VIII.50, F.I.S. No. A615A, ex. *Metasyrphus lapponicus* (3 ♀, NFRC). Obed, 21.VIII.50, F.I.S. No. A20H9C, ex. *Metasyrphus lapponicus* (4 ♀, NFRC). Rocky Mountain House, 23 mi. NW, 17.VIII.53, F.I.S. No. A781D, ex. syrphid, host prob. aphid (1 ♀, 1 ♂, NFRC). Seebe, 13.VI.68, ex. *Cromartium comandrae* (fungus), *Pinus contorta* var. *latifolia*, 688 1190 03. Manitoba: Picnic Bog, 6.VI.61,

F.I.S. (1 ♀, NFRC). Warkworth near Churchill, 29.VI.52, J.G. Chilcott (1 ♀). **Quebec:** Ct. Jetté, RIF '40, 5103B, em. 18.VIII, ex. Syrphidae sp.? (2 ♀). Forbes, 26.VI.52, L. Daviault, associated with *Choristoneura fumiferana*, rearing no. 20 (5 ♀). Laniel, 9.VIII.40, C.E. Atwood, experiment no. 12131-69, *Caecocia fumiferana* (2 ♀). Montcalm, em. 19.VI.11 from sp. B [?] worm, parasite of *Tortrix fumiferana* (1 ♂). **New Brunswick:** same data as holotype (2 ♀, 3 ♂; 1 ♀ and ♂ used for SEM). Fredericton, em. 8.VII.47, N.R. Brown, 18839-4d5, ex. *Neocnemodon coxalis* (8 ♀, 1 ♂). **Newfoundland and Labrador:** Gallants, 9.VII.57, 57-0016(01) B10 (4 ♀, AFRC), 14.VII.59, 59-6009(01) A1-A9 (1 ♀, 6 ♂), F.I.S., host: *Neodiprion abietis*. **Uncertain locality** (likely Newfoundland or New Brunswick): 23 [mi. ?] NW Rocky, 17.VIII.53, 53A781D, ex. syrphid (6 ♀, 8 ♂). **USA:** Alaska: Fairbanks, 23.VI.45, 45-19058, par. aphids on wild raspberry (1 ♀, USNM). **Colorado:** Green Mountain Falls, Canyon, 10.VIII.41, 10,000', H.H. Ross (1 ♀, INHS). **Idaho:** Bounds Creek, Fairfield, 5.IX.63, H. Flake & K. Lister, Hopk US no. 50-718a, host: attached pupae (Syrphidae) (8 ♀, USNM). **Maine:** Liberty, em. 8.VI.48, parasite 48-C11 syrphid fly, beaten ex. Fir (2 ♀, USNM). Megalloway, 23.VI.49, parasite 49-255, *Neodiprion abietis*, beaten ex. Fir (6 ♂, USNM). **Washington:** Yakima Co., Green Lake Road, 31.VIII.94, K.S. Pike, ex. *Blacus* sp. or ichneumonid, from *Cinara chinookiana* or unknown on *Abies lasiocarpa* (subalpine fir) (1 ♂, WSUC).

EXTRALIMITAL—FINLAND (FENNIA, SUOMI). *Savonia australis* [= Sa, ES]: Ristiina, 6826:502, 29.VII.83, M. Koponen (1 ♂, DAZH). *Ostrobothnia borealis*, N part [= ObN]: Pello, Pentik, 7417:368, 28.VI.97, V. Viikberg (1 ♀, VVPC). *Kuusamo* [= Ks]: Kuusamo, 7358:596, 27.VI.82, M. Koponen (1 ♀, DAZH).

Etymology.—From the Latin *brevis*, short, and *petiolus*, stalk, in reference to the transverse petiole of this species.

Female.—Head and mesosoma black with obscure metallic green luster under some angles of light; legs entirely black or, more often, black or dark brown with extreme apex of femora, extreme base and apex of tibiae to entire tibiae, and tarsi lighter in color, rufous to yellowish. Head subquadrate in frontal view (Fig. 1), width at most 1.2 times height, and in lateral view lower face abruptly to almost right-angled relative to upper face (Fig. 2); interorbital region in dorsal view deeply, broadly concave (Fig. 13); gena as long as or slightly longer than eye width and at

least 0.72 eye length; dorsal margin of torulus distinctly below lower orbit (Figs. 1, 2). Antenna (Fig. 19) with pedicel length about 3 times greatest width; funicle with fu_1 ring-like, fu_2 – fu_4 subquadrate (Fig. 20), and fu_5 – fu_8 increasingly transverse. Mesoscutum (Fig. 43) with mesoscutal lateral lobes broadly bare medially, and with fine engraved net-like sculpture over bare area. Scutellum mostly bare except along extreme anterior and lateral margins (Fig. 43); frenum with distinct, uniform, engraved net-like sculpture similar to scutellum (Fig. 50). Metapleuron with at most 5 setae anteroventrally, these setae mostly in line along base of metapleural flange. Forewing with basal cell evenly setose (Fig. 73); disc with narrow speculum, the speculum closed basally by setae and with one or more lines of setae immediately behind submarginal vein (Fig. 73). Petiole in dorsal view distinctly transverse, length 1.4–1.7 times width, reticulate with irregular longitudinal carinae or stronger keels (Fig. 49).

Male.—Antenna with scape, pedicel and fu_1 yellow to yellowish-orange, contrasting distinctly in color with rest of dark flagellum; color pattern otherwise similar to female except head and mesosoma usually with more distinct metallic green luster; legs usually more extensively light-colored, but at least hind leg brownish basally, including trochanter. Scape (Figs. 31–32) with dorsal margin slightly convex, ventral margin sinuate so as to be broadest subbasally and tapered to apex; inner and outer surfaces uniformly setose and sculptured. Pedicel (Figs. 31–32) length about 3 times width and about 0.40–0.45 scape length. Flagellum length subequal to head width; funicle (Fig. 31) with all segments at least slightly transverse or with one or more of fu_{3-5} quadrate to very slightly longer than wide. Structure otherwise similar to female except head in dorsal view with interorbital region even more deeply, broadly concave (Fig. 14); malar space only about 0.77–0.87 eye

width and 0.5–0.6 eye length; petiole usually only slightly transverse (Fig. 55); and sculpture of frenum often distinctly finer than on scutellum (Fig. 55). Setal pattern similar to female except metapleuron with at most 2 short setae.

Distribution.—Holarctic; in North America transcontinental within the Boreal region and extending south along the Cascade and Rocky Mountains into Colorado (Fig. 79).

Biology.—*Asaphes brevipetiolatus* is a parasite of *Neocnemodon coxalis* (Curran), *Metasyrphus lapponicus* (Zetterstedt) and possibly other Syrphidae (Diptera) based on associated host pupal remains and label data. The balsam fir sawfly is also indicated as a host because two cocoons of *Neodiprion abietis* (Harris), one with two emergence holes and the other torn in half, are preserved with specimens. Labels from three different rearings in Quebec indicate that *A. brevipetiolatus* is also a parasite of the spruce budworm, *Choristoneura fumiferana* (Clemens). Although there are no associated host pupae, one of the two Laniel specimens has an unidentified braconid cocoon preserved with it, indicating that *A. brevipetiolatus* could be a hyperparasite of the spruce budworm through braconid primary parasites. There is also a single record, based on label data, of the species parasitizing an unidentified aphid on wild raspberry, plus a rearing from either *Cinara chinookiana* Hottes or an unknown aphid via either *Blacus* sp. (Braconidae) or an unidentified ichneumonid.

More than one emergence hole in some syrphid puparia and one balsam fir sawfly cocoon, plus multiple-mounted specimens, labelling, or both, for these two hosts and two of the three spruce budworm records indicate that *A. brevipetiolatus* is often gregarious when parasitizing larger non-aphid hosts. It remains to be demonstrated more conclusively that the balsam fir sawfly and spruce budworm are more than just accidental hosts, and whether *A. brevipetiolatus* is a primary or

hyperparasite of these two species. However, based on current evidence it seems likely that host acceptance for *A. brevipetiolatus* includes not only syrphid larvae but other relatively large, oblong, brownish pupae or cocoons on coniferous trees. This suggests an evolutionary progression in *Asaphes* from parasitism of hymenopterous primary parasites of aphids, to syrphid-larvae predators of aphids and their parasites, to other hosts that resemble syrphid larvae.

Remarks.—Males are easily distinguished by structure and color of their scape and pedicel, both are yellowish in distinct contrast to the flagellum beyond fu₁. Also, the pedicel is conspicuously long, almost half the length of the scape, and the scape is widened subbasally so that its ventral margin is sinuate (Figs. 31, 32).

Females are distinguished by a combination of features, including a sculptured frenum (Fig. 50), dark trochanters and trochantelli, closed speculum (Fig. 73), transverse petiole (Fig. 49), and unique head structure (Figs. 1, 2). Because the legs are almost uniformly dark basally, females most closely resemble those of *A. vulgaris*, *A. petiolatus* and *A. hirsutus*, but are distinguished from all three species by described head structure. Absence of a broad speculum further differentiates females from those of *A. vulgaris*. Those *A. brevipetiolatus* females with setae on the metapleuron are more likely to be mistaken for females of *A. hirsutus*, particularly because some *A. hirsutus* females have a slightly transverse petiole (Fig. 53) and some have the frenum extensively, though finely sculptured. However, in *A. hirsutus* the frenum is always more or less broadly smooth immediately behind the frenal sulcus even though often sculptured posteriorly (Fig. 54). Only head structure readily differentiates females of *A. brevipetiolatus* and *A. petiolatus*.

Asaphes californicus Girault

(Figs. 7, 8, 21, 22, 33, 34, 44, 56, 63, 67, 68, 76)

Asaphes californicus Girault 1917[330]: 1. Type data: USA: California [Spreckels], [25] September [1916]; reared from [parasitized] *Aphis rumicis*; [Chittenden No. 1671]; C.F. Stahl [collector]. Sex described: female. Holotype by monotypy; USNM, type no. 21411.

Female.—Head and mesosoma dark with varying intensity of olive green metallic luster under some angles of light; legs with trochanters and trochantelli almost always uniformly yellowish to yellowish-brown, at least middle and hind femora black except often apically, and tibiae and tarsi usually yellowish to reddish-brown. Head transverse-triangular in frontal view (Fig. 7), width at least 1.25 times height, and in lateral view lower face evenly curved into upper face (Fig. 8); interorbital region in dorsal view relatively shallowly concave; gena length about 0.62–0.80 eye width and 0.50–0.65 eye length; dorsal margin of torulus approximately in line with lower orbit (Figs. 7, 8). Antenna (Figs. 21, 22) with pedicel length at most about 2.5 times width; funicle with fu_1 ring-like, fu_2 – fu_4 quadrate to transverse, and fu_5 – fu_8 increasingly transverse. Mesoscutum (Fig. 44) with lateral lobes broadly bare medially, and either smooth and shiny or with fine, engraved net-like sculpture over bare area. Scutellum (Fig. 44) mostly bare except along extreme anterior and lateral margins; frenum smooth and shiny except finely carinate laterally. Metapleuron bare. Forewing with basal cell evenly setose to bare except for single row of setae on dorsal surface (Fig. 68); disc often without distinct speculum, distance between either basal setal line or submarginal vein and first setal line on disc at most about equal to distance between first and third setal lines on disc (Fig. 67) or, if with large and conspicuous speculum, then bare region with at least 2 dorsal setae within bare region, the setae

usually separated from basal vein and/or submarginal vein by distance about equal to length of setae or less (Fig. 68). Petiole at least quadrate and usually slightly longer than wide, but less than 1.3 times as long as wide (Fig. 44), reticulate with irregular longitudinal carinae (Fig. 44) or stronger keels.

Male.—Color pattern similar to female except legs sometimes entirely yellow (more commonly with at least metafemur infusate to black); antenna usually uniformly brown to black except sometimes apex of pedicel and fu_1 lighter in color. Scape (Figs. 33, 34) length about 3.5–5.0 times width, ovoid to spindle-shaped, with dorsal and ventral margins convex to subparallel over most of length; outer surface with subbasal, ovoid to elongate-lanceolate, microsetose sensory region (Figs. 33, 34a); inner surface with line of ventrally directed setae, often from along fine ridge, paralleling ventral margin of scape below midline and mediolongitudinal bare, smooth band (Fig. 34b). Combined length of pedicel and flagellum less than 2.5 times scape length (Fig. 33) and at most subequal in length to head width; funicle with all segments at least slightly transverse or with one or more of fu_{2-5} quadrate to very slightly longer than wide. Structure and setal pattern otherwise similar to female except petiole always distinctly (about 1.25–1.80 times) longer than wide (Fig. 56) and sometimes entirely reticulate without longitudinal carinae.

Distribution.—Restricted to western North America within the Nearctic region, except for one anomalous record from Georgia (see further under 'Remarks') (Fig. 82). **CANADA**. Yukon Territory, British Columbia, Alberta. **USA**. Alaska, Arizona, California, Colorado, ? Georgia, Idaho, Kansas, New Mexico, Nevada, Oregon, Washington, Utah. **EXTRALIMITAL**. **MEXICO** (BMNH: ♀, ♂; CNCI: ♀, ♂; EMEC: ♀), **ARGENTINA** (MLPA: ♀, ♂; TAMU: ♀, ♂); **BOLIVIA** (USNM: ♀),

Table 1. Host information for *Asaphes californicus* based on observed specimens; a question mark follows rearings or identifications indicated as questionable on the labels. Unless otherwise footnoted, all 'aphid or other hosts' are Homoptera (Aphidoidea: Aphididae) and all 'associated primary hosts' are Hymenoptera (Braconidae: Aphidiinae).

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
	<i>Acanthocaudus</i> sp. ?	WA	WSUC
	<i>Aphidius</i> sp.	CA	USNM, UCRC
	<i>A. alius</i> Muesebeck	CA	UCRC
	<i>A. nigripes</i> Ashmead	CA	UCRC
	<i>A. smithi</i> Sharma & Subba Rao	CA	USNM, EMEC
	<i>Diaeretus</i> sp.	CA	UCRC
	<i>Ephedrus</i> sp.	CA	EMEC
	<i>Lysiphlebus</i> (<i>Adialytus</i>) <i>salicaphis</i> (Fitch)	CA	EMEC
	<i>L. (Phlebus)</i> <i>testaceipes</i> (Cresson)	CA	UCRC
	<i>Pauesia californicus</i> (Ashmead)	CA	USNM, EMEC
	<i>Praon</i> sp.	CA	UCRC
	<i>T. (Trioxys)</i> <i>complanatus</i> Quilis	CA	EMEC
	<i>T. (Trioxys)</i> <i>curvicaudus</i> Mackauer	CA	EMEC
	<i>Praon</i> sp.	WA	WSUC
<i>Acyrtosiphon lactucae</i> (Paserin)			
<i>A. pisum</i> (Harris)	<i>Aphidius</i> sp., <i>A. ervi</i> Haliday, <i>A. smithi</i> Sharma & Subba Rao	CA, OR, WA	UCRC, EMEC, USNM, WSUC
<i>Amphorophora rubi</i> (Kaltenbach)	<i>Praon pequodorum</i> Viereck	WA	WSUC
<i>Aphis</i> sp.		CA	EMEC, UCRC
<i>A. ceanothi</i> Clarke		WA	WSUC
<i>A. fabae</i> Scopoli	<i>Lysiphlebus</i> sp.	WA	WSUC
<i>A. gossypii</i> Glover	<i>Aphidius</i> sp.; <i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson)	CA, NM	EMEC, UCRC, USNM
<i>A. hederæ pseudohederæ</i> Theobald	<i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson)	CA	UCRC
<i>A. helianthi</i> Monell	<i>Ephedrus californicus</i> Baker; <i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson); <i>Praon</i> sp.	WA	WSUC
<i>A. holodisci</i> Robinson	<i>Alloxysta</i> sp.	WA	WSUC
<i>A. rumicis</i> L.		CA	USNM
<i>A. sambuci</i> L.		WA	WSUC
<i>A. spiraeicola</i> Patch		WA	WSUC
<i>A. varians</i> Patch		WA	WSUC
<i>Aphthargelia symphoricarpi</i> (Thomas)	<i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson); <i>Praon</i> sp.	WA	WSUC
<i>Brachycaudus cardui</i> (L.)		WA	WSUC
<i>B. helichrysi</i> (Kaltenbach)		CA	EMEC
<i>B. tragopogonis</i> (Kaltenbach)		WA	WSUC
<i>Brachycorynella asparagi</i> (Mordvilko)	<i>Diaeretiella rapae</i> (M'Intosh)	WA	WSUC
<i>Braggia</i> sp.	<i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson)	WA	WSUC
<i>B. eriogoni</i> (Cowen)		WA	WSUC
<i>Brevicoryne brassicae</i> (L.)	<i>Diaeretiella rapae</i> (M'Intosh)	CA, OR, WA	EMEC, OSUC, WSUC
<i>Capitophorus elaeagni</i> (del Guercio)		WA	WSUC
<i>Cavariella aegopodii</i> (Scopoli)	<i>Aphidius salicis</i> Haliday	CA, WA	CASC, WSUC
<i>C. pastinacae</i> (L.)	<i>Aphidius salicis</i> Haliday	WA	WSUC

Table 1. Continued.

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
<i>Chaetosiphon</i> (<i>Pentatrachopus</i>) <i>fragarae</i> (Cockerell)	<i>Aphidius</i> sp.	CA	UCRC, EMEC
<i>Chaitophorus populifolii</i> (Essig)	<i>Ephedrus</i> sp.	WA	WSUC
<i>Chaitophorus salicicola</i> Essig		CA	EMEC, USNM
<i>Cinara ponderosae</i> (Williams)	<i>Pauesia</i> sp.	MT	WSUC
<i>Diuraphis noxia</i> (Mordvilko)	<i>Diaretiella rapae</i> (M'Intosh)	WA	WSUC
<i>Dysaphis</i> (<i>Pomaphis</i>) <i>plantaginea</i> (Passerini)?	<i>Praon unicum</i> Smith	WA	WSUC
<i>Elatobium albidinum</i> (Walker)	<i>Aphidius</i> sp.	BC	UCRC, NFRC
<i>Ericaphis gentneri</i> (Mason)	<i>Alloxysta</i> sp.; <i>Praon unicum</i> Smith	WA	WSUC
<i>Essigella</i> sp.		CA	EMEC
<i>E. californica</i> (Essig)	<i>Diaeretis</i> sp.	CA	UCRC
<i>E. pini</i> Wilson	<i>Aphidius</i> sp.; <i>Diaeretis</i> sp.	CA	UCRC, USNM
<i>Eucallipterus tiliae</i> (L.)		CA	EMEC
<i>Euceraphis punctipennis</i> (Zetterstedt)	<i>Praon</i> sp.	CA	USNM
<i>Flabellomicrosiphum knowltoni</i> Smith?		WA	WSUC
<i>Hayhurstia atriplicis</i> (L.)	<i>Diaretiella rapae</i> (M'Intosh)	WA	WSUC
<i>Hyalopterus pruni</i> (Geoffroy)	<i>Praon</i> sp.	CA	EMEC
<i>Hyperomyzus</i> (<i>Neonasonovia</i>) <i>nigricornis</i> (Knowlton)	<i>Praon</i> sp.	WA	WSUC
<i>Illinoia</i> sp.	<i>Alloxysta</i> sp.; <i>Aphidius</i> sp.	WA	WSUC
<i>I. azaleae</i> (Mason)		WA	WSUC
<i>I. liriodendri</i> (Monell)		CA	CNCI, EMEC
<i>I. morrisoni</i> (Swain)		CA	EMEC
<i>I. simpsoni</i> (MacGillivray)		BC	EMEC
<i>I. subviridis</i> (MacDougall)	<i>Praon</i> sp.	WA	WSUC
<i>Macrosiphoniella ludoviciana</i> (Oestlund)	<i>Aphidius</i> sp.	CA	UCRC
<i>Macrosiphum</i> sp.	<i>Aphidius</i> sp.; <i>Praon</i> sp.	BC, CA, WA	CNCI, EMEC, WSUC
<i>M. clydesmithi</i> Robinson	<i>Praon</i> sp.	WA	WSUC
<i>M. creelii</i> Davis		WA	WSUC
<i>M. euphorbiae</i> (Thomas)	<i>Alloxysta</i> sp.; <i>Aphelinus</i> sp.; <i>Aphidius nigripes</i> Ashmead	CA	EMEC, UCRC
<i>M. parvifolii</i> Richards		BC	CNCI
<i>M. rosae</i> (L.)	<i>Aphelinus</i> sp.; <i>Aphidius</i> sp., <i>A. alius</i> Muesebeck; <i>Praon</i> sp.	CA, WA	CASC, EMEC, UCRC, USNM, WSUC
<i>Metopolophinum dirhodum</i> (Walker)		WA	WSUC
<i>Microlophium carnosum</i> (Buckton)	<i>Praon</i> sp.	WA	WSUC
<i>Myzocallis</i> sp.	<i>T. (Trioxys) pallidus</i> (Haliday)	WA	WSUC
<i>M. coryli</i> (Goeze)	<i>T. (Trioxys) pallidus</i> (Haliday)	WA	WSUC
<i>Myzus</i> (<i>Nectarosiphon</i>) <i>persicae</i> (Sulzer)	<i>Aphidius</i> sp., <i>A. matricariae</i> Haliday; <i>Diaeretis rapae</i> (M'Intosh); <i>Lysiphlebus</i> (<i>Phlebus</i>) <i>testaceipes</i> (Cresson); <i>Praon</i> sp., <i>P. unicum</i> Smith	AB, CA, OR, WA	CNCI, EMEC, UCRC, USNM, WSUC
<i>Nasonovia aquilegiae</i> (Essig)		WA	WSUC

Table 1. Continued.

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
<i>Obtusicauda</i> sp.		WA	WSUC
<i>O. artemisiphila</i> (Knowlton & Allen) ?		WA	WSUC
<i>O. coweni</i> (Hunter)		WA	WSUC
<i>O. filifoliae</i> (Gillette & Palmer) ?		WA	WSUC
<i>Ovatus crataegarius</i> (Walker) ?		WA	WSUC
<i>Phytomyza ilicis</i> Curtis ²		BC	CNCI
<i>Phorodon humuli</i> (Schrank)		WA	WSUC
<i>Pseudocameibaphis tridentatae</i> (Wilson)	<i>T. (Trioxys) bonnevillensis</i> Smith	WA	WSUC
<i>Rhodobium porosus</i> (Sanderson)		CA	EMEC
<i>Rhopalomyzus (Judenkoa) loniceriae</i> (Siebold)	<i>Praon</i> sp.	WA	WSUC
<i>Rhopalosiphum insertum</i> (Walker)	<i>Praon unicum</i> Smith	WA	WSUC
<i>R. maidis</i> (Fitch)	<i>Lysiphlebus (Phlebus) testaceipes</i> (Cresson)	WA	WSUC
<i>R. padi</i> (L.)		WA	WSUC
<i>Schizolachnus piniradiatae</i> (Davidson)		CA	USNM
<i>Sitobium avenae</i> (Fab.)	<i>Aphidius</i> sp., <i>A. avenaphis</i> (Fitch)	OR, WA	OSUC, WSUC
<i>S. pteridis</i> (Wilson)		BC, CA, OR	EMEC, UCRC
<i>Spilococcus implicatus</i> Ferris ³		CA	EMEC
<i>Therioaphis riehnii</i> (Börner)	<i>Praon americanum</i> (Ashmead)	CA	UCRC
<i>T. trifolii</i> (Monell)	<i>Praon exoletum palitans</i> Muesebeck; <i>Trioxys (Trioxys) complanatus</i> Quilis	CA	UCRC, USNM
<i>Thripsaphis</i> sp.	<i>Praon</i> sp.	WA	WSUC
<i>Uroleucon (Lambersius) katonkai</i> (Hottes)		CA	EMEC
<i>U. russellae</i> (Hille Ris Lambers)		WA	WSUC
<i>Wahlgreniella nervata</i> (Gillette)	<i>Praon</i> sp.	WA	WSUC

¹ Chalcidoidea (Aphelinidae).² Diptera (Agromyzidae).³ Coccoidea (Pseudococcidae).

CHILE (ANIC: ♀; BMNH: ♀, ♂; CNCI: ♀; EMEC: ♀; TAMU: ♀, ♂; UCDC: ♀, ♂), **COLOMBIA** (CNCI: ♀), **COSTA RICA** (CNCI: ♀, ♂), **DOMINICAN REPUBLIC** (CNCI: ♀, ♂), **ECUADOR** (CNCI: ♀), **GUATEMALA** (CNCI: ♀, ♂), **URUGUAY** (USNM: ♀), **VENEZUELA** (CNCI: ♀).

Biology.—Nearctic specimens with host data indicate that *A. californicus* is strictly a hyperparasite of aphids through aphidiine and aphelinid primary parasites,

though there are two anomalous records from *Phytomyza ilicis* Curtis and *Spilococcus implicatus* Ferris (Table 1).

Type material examined.—The holotype consists of a point-mounted specimen and, in the general collection, a slide with one hind leg and both antennae. The holotype otherwise has the head, right pair of wings, and right front leg missing.

Remarks.—We are uncertain both as to the limits of morphological variation and the true range of *A. californicus* because there may well be more than one species represented within a species complex in the New World. Our concept of *A. californicus* is influenced largely by the males, which have a more or less well developed, but usually elongate-lanceolate or oval, sensory region on the outer surface of the scape (Fig. 34a). Apparently the region is always setose but the setae are not always distinct because of what appears to be an exudate covering the area in some specimens. Also, the more elongate spindle-shaped is the scape, the less obvious is the line of setae on its inner surface (Fig. 34b) because the line is closer to the ventral margin. At least within the Nearctic region, females seem to have quite a stable leg color pattern, with at least the hind leg having yellowish trochanters in contrast to darker femora. The size of the speculum varies considerably, some individuals have a broad bare band like *A. vulgaris* (Fig. 68), others have the disc almost uniformly setose (Fig. 67), and others have intermediate states. Males and females from the Nearctic region, like other species recognized from the Northern Hemisphere, also consistently have a distinctly sulcate, crenulate frenal groove (Figs. 44, 56). Because males sometimes have the femora entirely yellow or only inconspicuously infusate they can easily be mistaken for males of *A. suspensus* if structure of the scape is not examined carefully. A difference in antennal color often suffices to differentiate unmounted males in ethanol. Males of *A. californicus* have uniformly brown antennae, whereas males of *A. suspensus* have the flagellum yellowish or at least distinctly lighter than the scape.

We have seen one anomalous female from Georgia (McIntosh Co., Sapelo Island, 28.IV–9.V.97, scrub sand dunes) (CNCI). Not only is this locality substantially outside the apparent range of *A. californicus*, the specimen has legs with the

trochanters to femora almost uniformly dark (trochantelli yellowish-brown, similar in color to tibiae), which is an aberrant color pattern for the species. A basally closed and relatively narrow speculum indicates that this specimen does not belong to *A. vulgaris*, and it does not possess the distinguishing features of other Nearctic species whose females are characterized by dark legs. The only species of *Asaphes* otherwise known to occur in the southeastern USA is *Asaphes suspensus*, which has entirely yellow legs. Because it was collected from coastal Georgia it is possible that it represents an accidentally introduced species that is morphologically similar to *A. californicus*. However, until additional females with associated males can be collected and examined, we tentatively include the female in *A. californicus*. The outlier from Kansas (Wellington, USNM: 2 ♀, 3 ♂) is typical of the species and definitively identified.

We have seen mostly females of *Asaphes* from the Neotropical region, but included are specimens from the countries listed above that either greatly increase limits of variation for *A. californicus*, *A. suspensus* and *A. vulgaris*, or that represent additional species that are very similar to these species. Some females look superficially like *A. suspensus* females because they have entirely yellow legs (sometimes also with the coxae brownish rather than dark with metallic luster). Others are similar to *A. vulgaris* females because they have the trochanters, trochantelli and femora, and sometimes also the tibiae and tarsi similarly dark. These, and other females having a color pattern more typical of *A. californicus*, can also have different combinations of the following features: speculum usually similarly broad as for *A. vulgaris*, though sometimes with 1–3 setae somewhere within the bare band; frenal groove often poorly developed, indicated only by a faint transverse line or if distinctly sulcate then not distinctly crenulate; mesonotum usually shiny with dis-

tinct metallic sheen, very finely net-like coriaceous with bare region of mesoscutal lateral lobe smooth; petiole often obviously elongate, 1.25–1.60 times as long as wide; petiole with strong longitudinal carinae and irregular surface sculpture to evenly, finely, longitudinally striate-reticulate without longitudinal carinae. Females with entirely yellow legs tend to have a shorter petiole with distinct carinae, and always a broad speculum that distinguishes them from *A. suspensus* females. Females with dark legs tend to have a more elongate petiole and/or one that is evenly sculptured without or with only obscure carinae, and often with three or more setae within or basally closing an otherwise broad speculum. Both color forms usually also have a non-crenulate frenal groove. Finally, all males seen from South America, including all those associated with any of the different female color forms, have a scape similar in structure to *A. californicus*, including a varied sensory region on the outer surface. Because of what currently appears to be a continuum of states in females and the presence of some sort of sensory region on the scape of all males we are uncertain of species limits in the Neotropical region. However, we have not seen any *Asaphes* from America south of Mexico that we believe belong to *A. suspensus* or *A. vulgaris* (see respective sections for these two species).

In addition to the New World we have seen males with an elongate sensory region on the outer surface of the scape from the Oriental region [India (CNCI), Taiwan (UCRC)] and the Palaearctic region [Iran (TAMU), Morocco (UCRC), Turkey (UCRC)]. The males from India and Taiwan appear to belong to an undescribed species based on a much longer flagellum—the combined length of the flagellum and pedicel in these specimens is more than 2.5 times the length of the scape and distinctly longer (more than 1.2 times) than the width of the head, and all but the apical one or two segments are monili-

form to slightly longer than wide. Males, and associated females, have yellowish or at least lighter-colored trochanters contrasting with variedly infusate or dark femora, a coloration similar to that in *A. californicus*. The females could be mistaken for those of *A. vulgaris* but both females and males have the speculum closed basally by setae or have a few setae within the speculum. Those males from Iran, Morocco and Turkey with an elongate sensory region on the outer surface of the scape are otherwise very similar to males of *A. suspensus*, including having a similar forewing setal pattern, entirely yellowish legs, and short antenna with the pedicel and flagellum, just the pedicel, or only the apex of the pedicel yellowish. Further, some males from Iran were reared along with typical males of *A. suspensus*. We could not find differences in associated females. It is unknown whether the sensory region on the scape of some males in the middle east and northern Africa indicates a separate species or whether scape structure is more variable for *A. suspensus* in these regions.

Asaphes hirsutus Gibson and Vikberg, new species

(Figs. 5, 6, 17, 18, 23, 24, 35, 36, 45, 53,
54, 57, 61, 62, 71, 74)

Type material.—Holotype, female (CNCI, Type No. 22266): CANADA, British Columbia, Cassiar Highway, Boyar Lake to Stikene River, 6.VIII.1988, S.&J. Peck, day car netting boreal forest. *Allotype*, male (CNCI): same data as holotype. *Paratypes*: CANADA, Yukon Territory: Dempster Hwy, 28.VI–2.VIII.82, D.M. Wood (2 ♀, 1 ♂). Heynes Junction 10, Deza-deash Lake, 700–900 m, 2.VIII.89, S.&J. Peck, car netting boreal dry forest (1 ♀). Herschel Island, 16–24, 26.VII.71, W.R.M. Mason (1 ♀, 1 ♂). Ross River, 16.VI–31.VIII.84, S.&J. Peck (3 ♀, 1 UCDC). Northwest Territories: Banks Island, Masik River, 10.VII.68, W.M. Mason (1 ♀). Salmita Mines, 64°05'N 111°15'W, 18.VI.53, J.G. Chillcott (1 ♀). British Columbia: same data as holotype (11 ♀, 5 ♂). Anahim Lake to Redstone, 1000–1500 m, 17.VII.88, S.&J. Peck, car netting pine sand land (2 ♀, 3 ♂). Charlie Lake, 25.VIII.80, R.J. Cannings (1 ♀, SMDV). Manning Provincial Park, 2 km N Blackwall Peak, 49°07'N 121°45'W, 2000 m, 9.VII.96, H. Goulet, subalpine

- meadow (1 ♂). McLeod Lake, 12.VII.66, #P66-7-12a, P.A. Rauch, *Castilleja* (1 ♂, EMEC); #F66-7-12e, F.G. Andrews, *Castilleja* (1 ♂, EMEC). Manning Provincial Park, 1400m, 12-14.VII.88, H. Goulet (2 ♀). Mt. Revelstoke, 51°02'N 118° 05'W, 1800m, 30.VII.86, H. Goulet (1 ♀). Mt. Seymour, N Vancouver, 790 m, 17.V.73, J.R. Vockeroth (1 ♂). Ocean Falls, 13.VII.60, E.I. Schlinger, 60-7-28P, secondary parasite reared from *Aphidius* sp., host aphid *Neomyzaphis abietina* (4 ♀, 4 ♂, UCRC). Squamish, Diamond Head Trail, 4600', 10, 11, 29, 30.VIII.53, W.R.M. Mason (8 ♀, 2 ♂). Summerland, 5.VI.59, R.E. Leech (1 ♂). Terrace, 18.VI.60, J.G. Chillcott (1 ♀). Vancouver Island, Forbidden Plateau, W of Courtenay, 1.VII.66, #F66-6-29b, on *Olopanax horridum* (1 ♀, 1 ♂, EMEC), #F66-7-1b, ex. aphids on *Achlys triphylla* (1 ♀, 1 ♂, EMEC), #F66-7-1e, ex. Macrosiphini on *Vaccinium ovalifolium* (1 ♂, EMEC), #F66-7-1f, 2 mi. NW of Courtenay, on manzita-like Ericaceae (2 ♂, EMEC), F.G. Andrews, Vancouver Island, 12 mi. E Port Alberni, 30.VI.66, P. Raunch, P66-6-30A, *Woodwardia* sp., *Macrosiphum pteridis* (1 ♀, 1 ♂, EMEC). Winfield, 20.III.54, F.I.S. no. 541, *Pinus ponderosa* cone (1 ♂). **Alberta:** Aspen Beach, 25.VIII.44, O. Peck (1 ♂). Edmonton, 11, 16, 22, 23, 24.V.46, 27.V.46, 2, 6, 17.VI.46, W.R.M. Mason (10 ♀, 8 ♂); 24.IX.86, Jorgensen & Anderson (5 ♂). Fortress Mountain, 6 km S, 51°52'N 115°10', 1700 m, 21.VI.86, H. Goulet (2 ♀). Fort McMurray, 30.VI.53, G.E. Ball (1 ♀). Seebe, reared from duff layer under *Pinus contorta* var. *latifolia*, em. 11.I.71, L.S. Skaley (2 ♂, NFRC). W Waterton Lake National Park, 49°05'N 113°52'W, 1300 m, 6.VII.91 (1 ♀), 3 km E Cameron Lake, 49°03'N 114°01'W, 1650 m, 13-14.VII.91 (1 ♂), H. Goulet. **Saskatchewan:** Prince Albert National Park, 23.VII.54, ex. *Cinara hottesi* (G. & P.), *Picea mariana* (1 ♀). Snowden, 26.VII.44, O. Peck (1 ♀). **Manitoba:** Winnipeg, coll. 31, 31-114, em. 28.VIII.86, H.G. Wylie (1 ♀, EDUM). **Quebec:** Chimo, 17-18.VIII.59, W.R.M. Mason (2 ♀, 4 ♂). Great Whale River, 11.VII, 31.VIII.49, J.R. Vockeroth (2 ♂); 8.VIII.59, sand dunes, W.R.M. Mason (1 ♂). Louvicourt, 16 km S, km 473.5, 17.VI.85, H. Goulet & D.R. Smith (6 ♀, 5 ♂). Parc de la Gaspésie, Mont Jacques-Cartier, 29.IX.91, C. Isabel, zone subalpine, sphaigne humide et krumholz (1 ♀). Mont Saint Marie, Low, 1800', 20.IX.65, J.R. Vockeroth (1 ♂). Québec City area, 29.VIII.88, reared ex. mummy *Aphidius nigripes* in potato field (1 ♀). St. Gedeon, 26.VIII.76, Remaudière, ex. *Calaphis* on *Betula* (3 ♂, BMNH). Ste-Catherine (de Portneuf), 5.VIII.87 (2 ♀), 18.VIII.87 (1 ♀), J. Brodeur. **New Brunswick:** Fredericton, 9.VIII.50, *Myzus persicae* on potato (1 ♂), 24.VIII.50, *Macrosiphum solanifolium* on potato (1 ♀), B.P. Spicer; 4.X.50, J.B. Adams, *Eulachnus agilis* on Scotch pine (1 ♂). Kouchibouguac National Park, 17.VII.77, I. Smith (1 ♀); 20.IX.77, S.J. Miller (1 ♀). St. John Co., Mary Pitcher Lake, IV.97, R'd D. O'Shea, aphid on *Picea glauca* needle (1 ♀). **Prince Edward Island:** Harrington, 23-29.VIII.86, M.E. Smith, in potato field (1 ♀). **Nova Scotia:** Coldbrook, 2, 7, 16, 30.X.63, H.B. Specht, host *Acyrtosiphum pisum* (Harris) on alfalfa (1 ♀, 5 ♂). Mantua, 23.X.63, H.B. Specht, host *Acyrtosiphum pisum* (Harris) on alfalfa (1 ♀). **Newfoundland and Labrador:** Junction Pond, Notre Dame Cp., 19.VII.61, C.P. Alexander (1 ♀, USNM). Labrador, Goose Bay, 7.VII.52 (1 ♀).
- USA. Alaska:** Bering Sea, St. Paul Island, T. Kincaid (1 ♀, 1 ♂, USNM), 16.VIII.15, G.D. Hanna (1 ♀, USNM). Cape Thompson, 25.VII.61, R. Madge (1 ♀). Cartwell, Denali Highway Route #8, mi. 85-130, 24.VII.84, S.&J. Peck (9 ♀, 7 ♂). Cold Bay, 163° W, 26.VII.52, W.R. Mason, on tundra (1 ♀). Colorado Creek, 60°40'N 149°30'W, 9.VII.94, ex. aphid mummies on *Alnus* sp., D. Collet (1 ♀, DCPC). Dave's Creek, 60°30'N 149°45'W, 3.IX.94, swept from *Salix barclayi*, D. Collet (1 ♂, DCPC). Deering, 8-19.VIII.68, J. Matthews (1 ♀, 1 ♂). Isabel Pass, mi. 206, Richardson Hwy, 2900', 17.VII.62, P.J. Skitsko (1 ♀). Kaslof, 60°15'N 151°15'W, 27.VI.94 (2 ♀, 2 ♂, DCPC), 30.VII.94 (2 ♀, DCPC), ex. aphid mummies on *Salix barclayi*, D. Collet. Kenai Peninsula, trail to Bryan glacier, vicinity Portage Glacier, 22.VII.78, P. H. Arnaud, Jr. (1 ♀, CASC). King Salmon, Naknek River, 15.VII.52, W.R. Mason (1 ♀). Kotzebue, 420, 14.VIII.58, Lindroth (1 ♀). Matanuska, 6.X.45, J.G. Chamberlin (2 ♀, USNM). Steese Highway, mi. 96.4, 4.IX.48, G. Jefferson (1 ♀, USNM). Soldotna, 60°30'N 151°00'W, 16.VII.95, ex. aphid mummies on *Betula*, D. Collet (2 ♀, DCPC). Sterling, in front of Collet house, 60°30'N 150°45'W, 23.VII.94 (1 ♀, DCPC), 31.VII.94 (1 ♂, DCPC), ex. aphid mummies on *Salix barclayi*, D. Collet; Gann site, 60°30'N 150°45'W, 4.V.93, swept from *Salix barclayi* (1 ♀, DCPC), 3.V.93, swept from *Betula nana* (1 ♀, DCPC), D. Collet. Unalakeet, 27.VI.61, B.S. Hemming (1 ♀); 15.VII.61, R. Madge (1 ♀). Unknown locality, 15.VIII.94, D. Collet (1 ♀, DCPC). **Arizona:** Cochise Co., Chiricahua Mountains, Rustler Park, 8000', 15.VIII.82, G.A.P. Gibson (2 ♀); 12 km S Sierra Vista, Ramsey Canyon, 1700 m, 1986, B.V. Brown (5 ♂). Tucson Co., Catalina Mountains, Mt. Lemmon, Crystal Springs Canyon, 8000', 11.VII.90, L. Masner (1 ♀). **California:** Glenn Co., Mendocino National Park, Plaskett Meadows, 7000', 28.VI.81, J.B. Whitfield (1 ♀, EMEC). Lake Tahoe, Pope Beach, 26.IX.75, E.C. Toftner & R.O. Schuster (1 ♀). Nevada Co., Sagehen Creek, 1.VII.70, *Salix*, E.E. Grissell (1 ♂, UCDC). Yosemite National Park, near Dog Lake, em IX.59, ex. *Essigella* mummy, *Pinus contorta* var. *murrayana* Englm. (1 ♂, UCRC); near Gaylor Lakes, X.59, *Pinus contorta* var. *murrayana* Englm. (1 ♂, UCRC). **Colorado:** Boulder Co., Chataqua Pk. W Boulder, 4.VI.90, S.L. Heydon (1 ♀, UCDC). Echo Lake, Mt. Evans, 10600', 8.VII.61, S.M. Clark (2 ♂). Estes Park, 11.VIII.53, R.R. Dreisbach (1 ♀, USNM). Fort Collins, 8651 km W, 4.VIII.72, R.B. Penfield, Hopkins US no. 36751-V-198, *Arceuthobium cyanocarpi* (1 ♂, USNM). New Castle, Hopkins US no. 34211-K, lot

- no. 47-946, *Picea engelmanni* (1 ♀, USNM). Pitkin Co., 10.5 km SE Aspen, 2900m, 9.VII.92, S.L. Heydon (2 ♂, UCDC). **Idaho:** Clarkia, 24.V.60, R.E. Denton, Hopkins US no. 20366, *Pinus monticola* foliage (1 ♂, USNM). Shoshone Co., Thompson Pass Summit, 29.VII.95, K.S. Pike, ex. *Aphidius polygonaphis* or *Praon humulaphidis* from *Illinoia* sp. on *Vaccinium* sp. (1 ♀, WSUC). **Maine:** Aroostook Co., 9.VI, 10, 21, 31.VII, 4, 10.IX.58, ex. *Macrosiphum solanifolii* (3 ♀, 4 ♂, USNM). **New Hampshire:** Mount Washington, 4.VIII.50, S. Ristich (1 ♀); 1676m, 20.VIII.81, H. Goulet (1 ♀); Alpine Garden, 5200–5600', 7.VIII.54, Becker, Monroe & Mason (1 ♀, 1 ♂); Cow Pasture, 5700', 2.VIII.54, Becker, Monroe & Mason (1 ♀); Lakes of the Clouds, 5000', 3, 9.VIII.54, Becker, Monroe & Mason (2 ♀, 1 ♂); Tuckerman's Ravine, 31.VII.54, Becker, Monroe & Mason (1 ♂). **New Mexico:** Lincoln National Forest, Karr Canyon, 28.VII.77, L. Masner (1 ♀, 1 ♂). Otero Co., 2 mi. N Cloudcroft, 5.VI.80, S.L. Heydon (1 ♀, UCDC). Valencia Co., 20 mi. W Los Lunas, Corritzo Arroyo, 1–23.VIII.77, S.&J. Peck (1 ♀). **Oregon:** Klamath Co., Sprague River, Hwy 87, Collier, 2.VII.85, D.G. Denning (1 ♂). **Washington:** Benton Co., WSU-Prosser Roza Unit, 27.VI.94, K.S. Pike, ex. *Aphidius ervi* from *Stibion avenae* on *Triticum aestivum* (wheat) (1 ♂, WSUC). Clallam Co., 10 mi. E Pysht, 26.VI.66, #C66-6-26a, D. Calvert (1 ♀, 1 ♂, EMEC); Lake Ozette, 24.VII.90, J.D. Pinto (2 ♀, 1 ♂). King Co., Stampede Pass lookout point, 8.VIII.96, K.S. Pike, unknown on *Rhododendron albiflorum* (white-flowered azalea) (1 ♀, WSUC). Kittitas Co., Lost Lake, 6.VIII.97, K.S. Pike, ex. *Aphidius* sp. from *Illinoia* sp. on *Lonicera involucrata* (black twinberry) (2 ♀, WSUC); Manashtash Cr., mile 8, 16.VIII.96, K.S. Pike, ex. *Alloxysta* sp. or *Aphidius ohioensis* or *Dendrocerus* sp. or *Ephedrus californicus* from *Macrosiphum creelii* on *Vicia* sp. (vetch) (2 ♀, WSUC); Manashtash Cr., mile 12, 25.VI.97, K.S. Pike, ex. *Alloxysta* or *Aphelinus* on *Lonicera involucrata* (1 ♀, WSUC); 2 mi E of Quartz Mtn, 25.VII.96, K.S. Pike, ex. *Aphidius* sp. or *Praon* sp. from unknown aphid on *Rubus lasiococcus* (dwarf bramble) (1 ♀). Lewis Co., Rainier National Park, Tipsoo Lake, 11.IX.96, K.S. Pike, from *Macrosiphum* sp. on *Rhododendron albiflorum* (white-flowered azalea) (1 ♀, WSUC). Mount Baker, 2.VIII.86, 1700 m, H. Goulet (2 ♀). Mount Rainier National Park, Van Trump Park, 1500–1800 m, 29.VII.85, L. Masner (8 ♀, 17 ♂). Pierce Co., Mount Rainier National Park, Chinook Pass, 8.IX.95, K.S. Pike, unknown on *Spiraea densiflora* (1 ♀, 1 ♂, WSUC). Wenatchee, 22.VII.83, D. Carroll, host *Schizaphis graminum* via *Praon* sp. on *Agropyron repens* (1 ♀, Carroll); near bridge, 17.VI.82, D. Carroll, host *Rhopalosiphum insertum* via *Praon unicum* on *Crataegus douglasii* (1 ♀, Carroll). Yakima Co., 15 mi. E of Chinook Pass, 11.IX.96, K.S. Pike, free flying parasitoids on *Achlys triphylla* (vanilla-leaf) (1 ♀, 1 ♂, WSUC); Green Lake, 20.VII.94, K.S. Pike, ex. *Alloxysta* sp. or *Monoctonus* sp. from *Illinoia* sp. on *Rhododendron albiflorum* (white-flowered azalea) (2 ♀, WSUC); Green Lake Road, 31.VIII.94, K.S. Pike, ex. *Blacus* sp. or ichneumonid, from *Cinara chinookiana* or unknown on *Abies lasiocarpa* (subalpine fir) (5 ♀, WSUC); trail, 1.5 mi. from Rd1010, 14.IX.95, K.S. Pike, ex. *Alloxysta* sp. or *Lysiphlebus testaceipes* from *Aphis fabae* on *Cirsium vulgare* (bull thistle) (13 ♀, 10 ♂, WSUC); Yakima Indian Reservation, Howard Lake, 19.IX.95, K.S. Pike, ex. *Aphidius polygonaphis* or *Praon* sp. from *Sitobion* sp. on *Pteridium aquilinum* (2 ♀, WSUC). **Wyoming:** Big Horn Co., Northern Big Horn Mountains, Sheep Mountain, 2800 m, 22.VII.88, H. Goulet (1 ♂).
- EXTRALIMITAL—Neotropical:** **MEXICO.** Rio Frio, 3150 m, 8.V.79, G. Remaudière, ex. *Macrosiphum* on *Euphorbia peplus* (5 ♀, 4 ♂ glued on 6 cards along with specimens of *A. californicus*, BMNH). **Palaeartic:** **AUSTRIA.** Dolomiten, S.-Tirol, Platzwiese, 200 m, Dürrenstein Geb., 1968, Schimitschek, ex. *Paesia similis* Sta. in *Cinara cembrae* (1 ♀, BMNH). **CZECH REPUBLIC.** **Bohemia:** Studnice, nr Jablonec nad Nisou, 860m, 28.VI.63, V. Martinek (1 ♀). Teplice, Nove Meste, 850m, 2.VII.63 (1 ♂), 12.VII.63 (1 ♂), 30.VII.63 (2 ♂), V. Martinek. **FINLAND** (FENNIA, SUOMI). **Karelia borealis** [= Kb]: Eno, Ahveninen, 698:65, 22.VIII.68, V. Vikberg (1 ♀, VVPC). **Ostrobothnia media** [= Om, KP]: Kestilä, 7135:461, 29.VI.78, M. Koponen (1 ♀, DAZH). **Ostrobothnia borealis**, **N part** [= ObN, PP]: Ranua, 7312:479, 20.VII.80, M. Koponen (1 ♂, DAZH). Rovaniemi, 737:44, 16.VIII.80, J. Halmé (5 ♀, 1 ♂, DAZH). **Kuusamo** [= Ks]: Kuusamo, 735:61, 2.VII.79, V. Vikberg (3 ♂, VVPC); 7366:603, 26.VI.79 (1 ♀), 30.VI.79 (4 ♀, 3 ♂), 26.VI.82 (1 ♀), M. Koponen (DAZH). **Lapponia kemensis**, **E part** [= LkE, KemL]: Sodankylä, 7481:467, 11.VIII.83 (1 ♂), 7582:516, 6.VII.89 (1 ♀), M. Koponen (DAZH). **Lapponia kemensis**, **W part** [= LkW]: Kolari, 7501:382, 6.VII.97, M. Koponen (2 ♀, 1 ♂, DAZH), 7504:379, 4.VII.97, K. Silvonén (1 ♀, DAZH); Kolari, Ylläs, 7502:380, 29.VI.97, V. Vikberg (1 ♀, VVPC); Kolari, Ylläs, Varkaankuru, 7502:382, V. Vikberg (1 ♀, VVPC). Muonio, Olostunturi, 7541:366, 28.VI.97, V. Vikberg (1 ♀, VVPC). **Lapponia enontekiensis** [= Le, EnL]: Hetta, 759:36, 3, 4.VII.82, V. Vikberg (2 ♀, VVPC). Karesuvanto, 760:31, 29.VI.82, V. Vikberg (1 ♀, VVPC); 7605:313, 29.VI.82, M. Koponen (2 ♀, DAZH). Kilpisjärvi, Pien Malla, 2.VII.50, W. Hellén (1 ♀, UZMH); region subalpina, 767:25, 17.VI.71, V. Vikberg (1 ♀, VVPC); Siilastupa, 1.VII.50 (1 ♂, UZMH), 10–19.VII.50 (1 ♀, UZMH), W. Hellén. Ropinsalmi, 2.VII.82, Y. Zhongqi (1 ♀, DAZH). **Lapponia inariensis** [= Li, InL]: Inari, 7591:478, 1.VII.89 (1 ♀), 7617:521, 6.VII.89 (2 ♀, 2 ♂), 7664:504, 12.VIII.83 (2 ♀), 7615:517, 4.VII.89 (2 ♀), M. Koponen (DAZH); Inari, kk [= kirkonkylä = 'church village'], 24.VI.60 (1 ♀), 28.VI.60 (1 ♀), 29.VI.60 (2 ♀), V. Vikberg (VVPC); Inari, Kaunispää, 154/80, 759:50, 12.VIII.80 (1 ♀, 1 ♂), 159:51, 11.VIII.80 (1 ♀), 159:51, 15.VIII.80 (2 ♀), J. Halmé (DAZH); Inari, Opukasjärvi, 772:55, 4.VII.60, V. Vikberg (1 ♀, VVPC). Utsjoki,

7741:500, 13.VIII.83, M. Koponen (1 ♀, DAZH); Utsjoki, kk [= kirkonkylä = 'church village'], 775:50, 4.VI.60 (1 ♀), 6.VI.60 (2 ♀, 1 ♂), 11.VI.60 (1 ♀), 16.VI.60 (4 ♀, 4 ♂), 18.VI.60 (1 ♀, 3 ♂), 19.VI.60 (2 ♀), 22.VI.60 (2 ♀), 29.VI.60 (2 ♀), V. Vikberg (VVPC); Utsjoki, Karigasniemi, 770:46, 30.VI.60, V. Vikberg (1 ♀, VVPC). **NORWAY.** Oppland [= O]: Dovre, Fokstua, 13.VII.53, W. Hellén (1 ♀, UZMH). **RUSSIA.** Khabarovsk Kray: Ochotsk [= Okhotsk], 1841, F. Sahlb. [= Sahlberg] (1 ♀, UZMH). **Kamchatka Oblast:** N. Kuril Islands, 5.VIII.64, aphid on *Salix* (3 ♂, ZMAS). **Murmansk Oblast:** Yläluostari, VII.30, W. Hellén (1 ♀, UZMH). **SWEDEN (SUECIA).** Norrbotten [= Nb.]: Boden, Trehörningen, RN 1783/7326 810722-22 [*Equisetum silvaticum*; *Sitobion equiseti*; *Aphidius picipes*], U. Gärdenfors (1 ♀, MZLU). Luleå, Lulviken, RN 1793/7286 810721-30, [*Ephedrus* mummy on needle of *Pinus sylvestris* on ground] (1 ♀, MZLU), RN 1793/7286 810721-11, [*Wahlgreniella vacinii*; *Praon myzophagum*, plus *Ephedrus plagiator*, plus *Aphidius* sp.; *Aphelinus* sp.] (2 ♀, 1 ♂, MZLU), U. Gärdenfors. Luleå, Svartösten, RN 1794/7288 800807-08, [*Epilobium angustifolium*; *Macrosiphum rosae*; *Aphidius* sp., plus *Ephedrus* sp.], U. Gärdenfors (1 ♀, MZLU). överkalix, RN 1815/7376 810722-08, [*Rosa* sp.; *Macrosiphum rosae*; *Praon* sp.] (1 ♂, MZLU), RN 1815/7376 810722-02, [*Lonicera* sp. culture; *Rhopalosiphum lonicerae*; *Ephedrus* sp.] (3 ♀, 8 ♂, MZLU), U. Gärdenfors. **Torne Lappmark** [= Lpl.]: Åbisko, 15.VIII.51, J.R. Vockeroth (1 ♀).

Etymology.—From the Latin *hirsutus*, hairy, in reference to the partially setose metapleuron.

Female.—Head and mesosoma dark, usually with obscure metallic green luster under some angles of light; legs entirely dark or with at least coxae, trochanters and most of femora dark, the trochantelli sometimes, femora apically, and tibiae and tarsi often yellowish or distinctly lighter in color than rest of legs. Head transverse-subtriangular in frontal view (Fig. 5), width at least 1.25 times height, and in lateral view lower face evenly curved into upper face (Fig. 6); interorbital region in dorsal view relatively shallowly concave (Fig. 17); gena length about 0.64–0.82 eye width and 0.53–0.66 eye length; dorsal margin of torulus approximately in line with lower orbit (Figs. 5, 6). Antenna (Figs. 23–24) with pedicel length about 2.5–3.0 times greatest width; funicle with fu_1 transverse, fu_2 – fu_6 transverse to very

slightly longer than wide (fu_3 – fu_5 or fu_6 , usually more or less moniliform), fu_7 quadrate to slightly transverse, and fu_8 transverse. Mesoscutum (Fig. 45) with lateral lobes broadly bare medially, and with fine engraved net-like sculpture over at least posterior half of bare area. Scutellum (Fig. 45) mostly bare except along extreme anterior and lateral margins; frenum broadly smooth and shiny or with lateral longitudinal rugae continued narrowly along posterior margin and with fine, engraved, net-like sculpture except for anteromedial smooth region (Figs. 53, 54). Metapleuron with at least a few setae in anteroventral angle and often extensively setose (Figs. 61, 62). Forewing with basal cell often evenly setose (Fig. 71) but at least setose apically and with one or more lines of setae along length; disc either without evident speculum (Fig. 71) or speculum narrow, closed basally by setae and with line or lines of setae close to submarginal vein. Petiole in dorsal view slightly transverse to longer than wide, length 0.8–1.2 times width, reticulate with irregular longitudinal carina or stronger keels (Figs. 45, 53).

Male.—Color pattern similar to female except legs sometimes more extensively light-colored, rarely almost uniformly yellow beyond coxae, the femora only slightly infusate; antenna uniformly dark. Scape (Figs. 35, 36) length about 3.7–4.5 times greatest width, often widest subbasally but at least slightly tapered to apex, and in lateral view inner surface evenly setose but with flat to slightly concave ventrally or externally angled, sparsely setose or bare and shiny, surface over at least apical two-thirds (Fig. 36a). Pedicel (Figs. 35, 36) length about 2–2.25 times width and about 0.36–0.47 scape length. Combined length of pedicel and flagellum less than 2.5 times scape length, and flagellum at most as long as width of head; funicle (Fig. 35) with all segments slightly to distinctly transverse or with one or more of fu_{2-6} slightly longer than wide,

quadrate, or moniliform (segments increasingly more transverse apically). Structure otherwise similar to female except petiole always at least slightly longer than wide, about 1.1–1.66 times as long as wide (Fig. 57). Setal patterns similar to female except more commonly with only a few setae in anteroventral angle of metapleuron.

Distribution.—Holarctic; in North America transcontinental across the Boreal region and extending south within and west of the Rocky Mountains in the USA (Fig. 80) and into Mexico along the Sierra Madre Occidental.

Biology.—All host records indicate that *A. hirsutus* is a hyperparasite of aphids, including: *Acyrtosiphon pisum* (Harris), *Aphis fabae* Scopoli, *Calaphis* sp., *Cinara cembrae* (Seitner), *Cinara chinookiana* Hottes?, *Cinara hottesi* (Gillette & Palmer), *Elatobium abietinum* (Walker), *Essigella* sp., *Eulachnus agilis* (Kaltenbach), *Illinoia* sp., *Macrosiphum creelii* Davis, *Macrosiphum euphorbiae* (Thomas), *Myzus persicae* (Sulzer), *Rhopalosiphum insertum* (Walker), *Sitobion avenae* (Fabricius), *Sitobion pteridis* (Wilson), and *Schizaphis graminum* (Rondani). Label data also indicate species of *Praon* and *Aphidius* (Braconidae), and possibly *Alloxysta*, *Blacus*, *Lysiphlebus*, *Ephedrus*, *Monoctonus* (Braconidae) and *Dendrocerus* (Megaspilidae), as host primary parasites.

Remarks.—In addition to the paratypic material listed above, in 1984 the junior author examined two females and two males of *A. hirsutus* from the Greenland Hymenoptera Collection of the Zoological Museum, University of Copenhagen, Denmark. Lundbeck (1897) collected these specimens in 1889 from Arsuk and Sermiligârssuk fjord (= Sermiliarsuk) in southwestern Greenland. The four specimens had 1955 determination labels by O. Bakkendorf, as *A. vulgaris*. At the time of preparation of this manuscript these specimens could not be located in the museum (N. Kristensen, pers. comm.). However, they formed the basis for the literature re-

cords of *A. vulgaris* in Greenland cited in Bakkendorf (1955). It is possible that all records of *A. vulgaris* from Greenland are based on misidentifications of *A. hirsutus*.

The setose metapleuron (Figs. 61, 62) readily distinguishes most males and females of *A. hirsutus* from most other species of *Asaphes* in the Nearctic region. Those specimens with only a few setae within the anteroventral angle of the metapleuron are very similar to individuals of *A. petiolatus* but females of *A. petiolatus*, at least in the Nearctic region, have a distinctly sculptured frenum (Fig. 52). In addition to the absence of any setae on the metapleuron, males of *A. petiolatus* also have a slightly different structure of the scape. In lateral view the scape is more elongate-slender, without a distinct ventrally or externally angled surface but with a longitudinal, bare, shiny band on the inner surface, at least in larger specimens (cf. Figs. 36, 38). Some *A. brevipetiolatus* females also have setae on the metapleuron but are distinguished by head structure from *A. hirsutus* females. The combination of almost uniformly setose forewing and dark trochanters will differentiate females from those of *A. vulgaris* and *A. californicus*, respectively. Because of its setose metapleuron, setose forewings, and relatively dark legs, *A. hirsutus* is also very similar to the Japanese species *A. pubescens* Kamiyo and Takada, but is distinguished by having the mesoscutal lateral lobes broadly bare medially (Fig. 45) rather than evenly setose. We saw three females from Nepal (CNCI) with the metapleuron entirely setose, which closely resemble *A. pubescens* because they have the mesonotal lateral lobes evenly setose. These specimens likely belong to an undescribed species because the flagellar segments, including fu_3 , are all at least slightly transverse.

Asaphes petiolatus Zetterstedt,
revised status

(Figs. 25, 26, 37, 38, 46, 51, 52, 58, 65, 72, 75)

Asaphes petiolatus Zetterstedt 1838: 423. Type data: Lapponia [Swedish Lapland]: Wittangi.

Sex described: female. Holotype by monotypy; MZLU.

Female.—Head and mesosoma black with obscure metallic green luster under some angles of light [some western European females with distinct metallic green luster]; legs entirely black or, more often, black to dark brown with extreme apex of femora, extreme base and apex of tibiae to entire tibiae, and tarsi lighter in color, rufous to yellowish. Head transverse-subtriangular in frontal view, width at least 1.25 times height, and in lateral view lower face evenly curved into upper face; interorbital region in dorsal view relatively shallowly concave; gena length about 0.72–0.85 eye width and 0.57–0.65 eye length; dorsal margin of torulus approximately in line with lower orbit. Antenna (Figs. 25, 26) with pedicel length about 2.0–2.5 times greatest width; funicle with fu_1 ring-like, fu_2 quadrate to slightly longer than wide, fu_3 – fu_5 or fu_3 – fu_6 subquadrate, but at least fu_7 and fu_8 transverse. Mesoscutum (Fig. 46) with lateral lobes broadly bare medially, and with fine engraved net-like sculpture over bare area. Scutellum mostly bare except along extreme anterior and lateral margins (Fig. 46); frenum with distinct, uniform, engraved net-like sculpture similar to scutellum (Figs. 51, 52) [some specimens from western Europe with frenum medially or mostly shiny and smooth except for very fine and obscure net-like sculpture]. Metapleuron bare (Fig. 65). Forewing with basal cell evenly setose (Fig. 72); disc with speculum closed basally by setae and with line or lines of setae close to submarginal vein (Fig. 72). Petiole in dorsal view variedly distinctly, almost always definitely transverse (Fig. 51), width 1.15–1.3 times length, reticulate with irregular longitudinal carinae or stronger keels.

Male.—Color pattern similar to female [western European specimens sometimes with head and mesosoma having distinct metallic green luster; legs usually more

extensively light-colored, sometimes almost entirely yellow except metafemur partly infusate]; antenna uniformly dark. Scape (Figs. 37, 38) length about 4.5–5.5 times greatest width, spindle-shaped with ventral and dorsal margins symmetrically tapered to apex; in lateral view with flat ventral surface differentiated only near pedicel, and at least larger individuals with elongate, bare, smooth band over most of inner surface (Fig. 38b). Pedicel length about 2.0–2.5 times width and about 0.36–0.42 scape length (Figs. 37, 38). Combined length of pedicel and flagellum less than 2.5 times scape length, and flagellum length slightly less than head width; funicle (Fig. 37) with at least fu_1 and fu_2 subquadrate to moniliform, and sometimes with fu_2 longer than wide and fu_{3-5} subquadrate to moniliform. Structure otherwise similar to female except malar space about 0.62–0.74 eye width and about 0.51–0.54 eye length; petiole subquadrate to definitely longer than wide, but length less than 1.25 times width (Fig. 58). Setal patterns similar to female.

Distribution.—Holarctic; in North America restricted to the Boreal region (Fig. 79) and not commonly collected. **CANADA. Northwest Territories:** Kovaluk River [69°11'N 131°W], 2–6.VIII.71, W.R.M. Mason (1 ♀). **British Columbia:** Upper Carmanah Valley, UTM 10U CJ 801991, 28.VII.92, N. Winchester (2 ♂, PFRC). **Alberta:** Edmonton, 10.IX.86, A.T. Finnamore (1 ♀); 24.IX.86, Jorgensen & Andrews (1 ♂, used for SEM). **Saskatchewan:** Prince Albert National Park, 23.VII.54, ex. *Cinara hottesi* (G. & P.) (2 ♀, 1 used for SEM). Hudson Bay, 15.IX.59, J.R. Vockeroth (2 ♂). **Manitoba:** Warkworth Creek near Churchill, 21.VI.52, J.G. Chillcott (1 ♀). **Ontario:** Wawa, 2.VII.57, Forest Insect Survey record no. 710 (1 ♀). **Quebec:** Lac Brule, 7.VIII.45, O. Peck (1 ♀). **USA. Alaska:** Sterling, in front of Collet house, 60°30'N 150°45'W, 3.VIII.94, ex. aphid mummies on *Picea glauca*, D. Collet (1 ♀, DCPC). **EXTRALIMITAL. FIN-**

LAND (DAZH, VVPC), ITALY (BMNH), SWEDEN (CNCI, MZLU), SWITZERLAND (BMNH).

Biology.—Apparently a hyperparasite of aphids in North America, including *Cinara hottesi* (Gillette & Palmer).

Type material examined.—The holotype female of *A. petiolatus* is glued by its metasoma to the side of a pin that also bears the holotype of *Pteromalus violaceus* Zetterstedt (see Graham 1969: 81). It is entire, except for the right antenna beyond the pedicel, and has the following features: frenum almost entirely coriaceous except for narrow median smooth band that does not quite extend to the posterior margin of the frenum; speculum closed basally by setae and with four, almost evenly spaced, setae behind the submarginal vein that are separated from the vein by a distance less than the length of a seta; petiole about 1.2 times as wide as long; and head and mesosoma with only relatively obscure metallic green luster under some angles of light.

Remarks.—We have seen too few specimens of this species to estimate limits of variation reliably, both within the Nearctic region and across its known range. All Nearctic females seen had the frenum distinctly sculptured whereas some females from western Europe have a shiny, only very finely and obscurely sculptured frenum. Males from both regions have the frenum quite shiny, smooth medially though finely sculptured paramedially. Such males from the Nearctic had only very obscure metallic green luster and dark legs, whereas those from western Europe were distinctly metallic green and had the legs almost entirely yellow except for a partly infuscate metatrochanter and/or metafemur. These males could easily be mistaken for males of *A. suspensus* because of their indistinct speculum and shallowly concave interorbital region, but the antenna is uniformly dark and the scape and basal flagellar segments are more elongate than for males of *A. suspensus* (cf. Figs. 37,

39). Most males and females of *A. petiolatus*, particularly those with the frenum more or less smooth and shiny medially, are more likely to be mistaken for those of *A. vulgaris*. However, in addition to having a narrow, closed speculum, *A. petiolatus* also has the interorbital region more shallowly concave (cf. Fig. 17) and usually has an obviously shorter petiole than *A. vulgaris* (cf. Figs. 58, 60). In both species the petiole of the female is shorter relative to the male so that females of *A. petiolatus* usually have an obviously transverse petiole (Fig. 46) whereas *A. vulgaris* females have the petiole at least quadrate and almost always slightly to distinctly longer than wide (Fig. 48). Males of *A. petiolatus* usually have a subquadrate to only slightly elongate petiole (Fig. 58), whereas males of *A. vulgaris* have a more obviously elongate petiole (Fig. 60). However, in both cases the most elongate petioles of specimens assigned to *A. petiolatus* approach the least elongate petioles of specimens assigned to *A. vulgaris* based on forewing setal pattern. Structures of the scape are also similar. Males of *A. vulgaris* do not have a distinct bare band on the inner surface of the scape (cf. Figs. 38b, 42b), but because of poor preservation of specimens we are uncertain whether this feature is characteristic of and distinct for all *A. petiolatus* males. Except for the absence of any metapleural setae, males of *A. petiolatus* are also quite similar to males of *A. hirsutus*. The slight differences in described scape structure of the two species help to differentiate those males of *A. hirsutus* that have only a few inconspicuous setae (see 'Remarks' for *A. hirsutus*). Only head structure reliably distinguishes females of *A. petiolatus* and *A. brevipetiolatus*.

Asaphes suspensus (Nees)

(Figs. 9, 10, 16, 27, 28, 39, 40, 47, 59, 66, 69, 77, 78)

Chrysolampus suspensus Nees 1834: 127. Type data: Germany: Sickershusi province, 2 July 1813; reared from *Aphidii rosarum*. Female de-

- scribed. Lectotype designated by Graham 1969: 82; Hope Entomological Collection, Oxford, England.
- Chrysolampus altiventris* Nees 1834: 127. Type data: Germany: Sickershausen [female: 21 April 1811; male: 17 September]. Both sexes described. Syntypes, lost. Synonymy by Graham, 1969: 82.
- Pteromalus petioliventris* Zetterstedt 1838: 429. Type data: Lapponia [Swedish Lapland] between Karesuando and Kengis in August. Described questionably as male [Graham, 1969: 82 erroneously stated that it was described as a female]. Holotype male by monotypy; MZLU. Synonymy by Graham, 1969: 82.
- ? *Colax aphidii* Curtis 1842: 60. Unknown type status, lost. Tentative synonymy by Graham 1969: 82, based on original description.
- Chrysolampus aphidiphagus* Ratzeburg 1844: 181. Holotype, lost. Synonymy by Graham 1969: 82, based on original description; incorrectly synonymized with *A. vulgaris* by Kurdjumov 1913: 24.
- Chrysolampus aphidicola* Rondani 1848: 19–21. Type data: reared from an aphid [*Aphis rosae*]. Female described. Lectotype designated by Bouček 1974: 244; Museo Zoologico 'La Specola', Florence, Italy. Synonymy by Bouček 1974: 244, 275; incorrectly synonymized with *A. vulgaris* by Delucchi 1955: 174.
- Euplectrus lucens* Provancher 1887: 207. Type data: Canada: Quebec, Cap Rouge; Ontario, Ottawa. Female described. Lectotype designated by Gahan and Rohwer 1917: 399; Université Laval Insect Collection, Québec City, Canada, type no. 1369. **New synonymy.**
- Asaphes rufipes* Brues 1908: 160. Type data: USA: Massachusetts, Forest Hills, 30.X.1908, P. Hayhurst; reared from *Aphis*, probably *A. atriplicis* L., on *Chenopodium album*. Female described. Holotype by original designation; MCPM. **New synonymy.**
- Megorisimus Fletcheri* Crawford 1909: 98. Type data: Ottawa [15 Aug.] Canada [emerged]; bred from [ex.] *Nectarophora pisi*; Arthur Gibson collector. Both sexes described. Holotype female by original designation; USNM, type no. 12197. Previous synonymy with *A. lucens* by Burks, 1964: 1258. **New synonymy.**
- Asaphes americana* Girault 1914[219]: 114. Type data: USA: Iowa, Hampton, June 1912, R.L. Webster, exp. 101. Both sexes described. Lectotype female hereby designated; USNM, type no. 15655. Previous synonymy with *A. fletcheri* by Burks, 1958: 74 and with *A. lucens* by Burks, 1964: 1258. **New synonymy.**
- Pachycrepoides indicus* Bhatnagar 1951: 160–163. Type data: India: Chaubattia (U.P.), 15.V.1946, Z.A. Siddiqi; reared from *Aphis helichrysi* Kalt. Female described. Holotype by monotypy; type depository unknown. Tentative synonymy with *A. vulgaris* by Bouček et al. 1978: 437, based on original description and illustrations. **New synonymy.**
- ? *Asaphes sawraji* Sharma & Subba Rao 1958: 181–183. Type data: India: Kalka, Punjab; reared from *Acyrtosiphon* (*Macrosiphon*) *pisi* on the garden pea, *Lathyrus odoratus* L. Both sexes described. Unknown type status; IARI. Synonymy by Bouček et al. 1978: 436–437.
- Pachyneuron uniarticulata* Mani & Saraswat 1974: 96–98. Type data: India: Northwest Himalayas, Dalhousie (Ahla catchment area), M.K. Kamath, 25.V.1971. Female described. Holotype by original designation; USNM. Synonymy by Bouček et al. 1978: 436–437.
- Asaphes vulgaris*; McMullen 1966: 236, 239; McMullen 1971: 34; Philogene and Chang 1978: 54; Batulla and Robinson 1985: 36. Misidentifications of *A. suspensus*.
- Female*.—Head and mesosoma with metallic green luster under some angles of light, and usually bright metallic; legs usually uniformly light-colored, yellowish to yellowish-orange, but femora sometimes darker, yellowish-brown, medially. Head transverse-subtriangular in frontal view (Fig. 9), width at least 1.25 times height, and in lateral view lower face evenly curved into upper face; interorbital region in dorsal view shallowly concave (Fig. 16); gena length about 0.6–0.72 eye width and 0.5–0.65 eye length; dorsal margin of torulus approximately in line with lower orbit (Figs. 9, 10). Antenna (Figs. 27, 28) with pedicel length at most about twice width; funicle with fu_1 strongly transverse, fu_2 ring-like, and usually all segments at least slightly transverse, but fu_3 – fu_5 sometimes moniliform. Mesoscutum (Fig. 47) with lateral lobes broadly bare medially, and with finely engraved

Table 2. Host information for *Asaphes suspensus* based on observed specimens; a question mark follows rearings or identifications indicated as questionable on the labels. Unless otherwise footnoted, all 'aphid or other hosts' are Homoptera (Aphidoidea: Aphididae) and all 'associated primary hosts' are Hymenoptera (Braconidae: Aphidiinae).

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
	<i>Aphelinus semiflavus</i> ¹ Howard	OH	USNM
	<i>Aphelinus</i> sp. ¹	OH	USNM
	<i>Aphidius</i> sp.	CA, NY	CUIC, USNM
	<i>A. smithi</i> Sharma & Subba Rao	CA	EMEC
	<i>Ephedrus incompletus</i> Provancher	VA	USNM
	<i>Praon aguti</i> Smith	CA	EMEC
	<i>P. exoletum palitans</i> Muesebeck	CA	EMEC, USNM
	<i>T. (Trioxys) complanatus</i> Quilis	CA	EMEC
	<i>T. (Trioxys) pallidus</i> (Haliday)	CA	EMEC
<i>Acaudus convolvuli</i> Nevsky ?		NB	CNCI
<i>Acyrtosiphon lactucae</i> (Passerini)	<i>Praon</i> sp.	WA	WSUC
<i>A. pisum</i> (Harris)	<i>Aphidius</i> sp., <i>A. ervi</i> Haliday; <i>Praon</i> sp.	CA, IL, MB, NB, NS, OH, ON, OR, WA	CNCI, EDUM, EMEC, INHS, OSUC, USNM, WSUC
<i>Amphorophora rubi</i> (Kaltenbach) ?		WA	WSUC
<i>Aphis atriplicis</i> (L.)		MA	CUIC
<i>A. brassicae</i> L.		CA, IA, KS	USNM
<i>A. craccivora</i> Koch	<i>Lysiphlebus (Phlebus) testaceipes</i> (Cresson)	WA	WSUC
<i>A. fabae</i> Scopoli	<i>Lysiphlebus</i> sp.	WA	WSUC
<i>A. gossypii</i> Glover		CA, DC	UCRC, USNM
<i>A. helianthi</i> Monell	<i>Praon</i> sp., <i>P. unicum</i> Smith	WA	WSUC
<i>A. holodisci</i> Robinson		WA	WSUC
<i>A. illinoisensis</i> Shimer		DE	USNM
<i>A. nasturtii</i> Kaltenbach		ON	CNCI
<i>A. rumicis</i> L.		AB, CA, NB	CNCI, USNM
<i>A. spiraeicola</i> Patch ?	<i>Alloxysta</i> sp.	WA, WV	USNM, WSUC
<i>A. vitis</i> Scopoli		KS	USNM
<i>Aphthargelia symphoricarpi</i> (Thomas)	<i>Lysiphlebus (Phlebus) testaceipes</i> (Cresson)	WA	WSUC
<i>Brachycaudus helichrysi</i> (Kaltenbach)	<i>Praon</i> sp.	WA	WSUC
<i>B. (Appelia) tragopogonis</i> (Kaltenbach)		WA	WSUC
<i>Brachycornella asparagi</i> (Modviko)	<i>Diaeretiella rapae</i> (M'Intosh)	WA	WSUC
<i>Braggia</i> sp.		WA	WSUC
<i>Brevicoryne brassicae</i> (L.)	<i>Aphidius ervi</i> Haliday; <i>Diaeretiella rapae</i> (M'Intosh)	CA, MD, WA, WI	EMEC, USNM, WSUC
<i>Calaphis betulaecolens</i> (Fitch)		NB	CNCI
<i>Caviarella aegopodii</i> (Scopoli)	<i>Aphidius salicis</i> Haliday	NB, WA	CNCI, WSUC
<i>Chaitophorus salicicola</i> Essig		CA	USNM
<i>Chaetosiphon (Pentatrichopus) fragae-folii</i> (Cockerell)		CA	UCRC
<i>Chromaphis juglandicola</i> (Kaltenbach) ?	<i>T. (Trioxys) pallidus</i> (Haliday)	WA	WSUC

Table 2. Continued.

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
<i>Diuraphis noxia</i> (Mordvilko)	<i>Aphidius ervi</i> Halliday; <i>Diaeretiella rapae</i> (M'Intosh)	TX, WA	TAMU, WSUC
<i>Dysaphis</i> (<i>Pomaphis</i>) <i>plantaginica</i> (Passerini)	<i>Praon</i> sp., <i>P. unicum</i> Smith	WA	WSUC
<i>Elatobium abietinum</i> (Walker)		BC	NFRC
<i>Ericaphis gentneri</i> (Mason)	<i>Praon unicum</i> Smith	WA	WSUC
<i>Eriosoma americanum</i> (Riley)		SK	CNCI
<i>E. lanuginosum</i> (Hartig)	<i>Aphelinus mali</i> (Haldeman) ¹	NY	USNM
<i>Eucallipterus tiliae</i> (L.)		CA	CNCI
<i>Euceraphis punctipennis</i> (Zetterstedt)		CA	USNM
<i>Hayhurstia atriplicis</i> (L.)		WA	WSUC
<i>Hyalopterus pruni</i> (Geoffroy)		CA	EMEC
<i>Hyperomyzus lactucae</i> (L.)		NB, WA	CNCI, WSUC
<i>Hyperomyzus</i> (<i>Neonasonovia</i>) <i>nigricornis</i> (Knowlton)	<i>Praon</i> sp.	WA	WSUC
<i>Illinoia</i> sp.	<i>Alloxysta</i> sp.	WA	WSUC
<i>I. liriodendri</i> (Monell)		CA, DC	EMEC, USNM
<i>I. spiracae</i> (MacGillivray)		ME, WA	USNM, WSUC
<i>Lipaphis erysimi</i> (Kaltenbach)		CA, OK	CNCI, EMEC
<i>Liosomaphis berberidis</i> (Kaltenbach)		NB	CNCI
<i>Macrosiphoneilla ludoviciana</i> (Oestlund)	<i>Praon</i> sp.	WA	WSUC
<i>Macrosiphum</i> sp.	<i>Aphidius</i> sp.; <i>Praon</i> sp.	NB, OH, ON, WA	CNCI, USNM
<i>M. creelii</i> Davis		WA	WSUC
<i>M. euphoribae</i> (Thomas)	<i>Praon</i> sp.	DC, ME, NB, NJ, WA, WI	CNCI, USNM, UWEM, WSUC
<i>M. rosae</i> (L.)	<i>Aphidius</i> sp.	CA	CASC, UCRC
<i>Malacosoma</i> sp. ²		BC	CNCI
<i>Metopolophium dirhodum</i> (Walker)	<i>Praon</i> sp.	WA	WSUC
<i>Monellia caryae</i> (Monell)	<i>Trioxys</i> sp.	WA	WSUC
<i>Myzaphis rosarum</i> (Kaltenbach)		DC	USNM
<i>Myzus</i> (<i>Nectarosiphon</i>) <i>persicae</i> (Sulzer)	<i>Aphidius</i> sp.; <i>Diaeretiella rapae</i> (M'Intosh); <i>Praon</i> sp., <i>P. unicum</i> Smith	CA, MD, MN, NB, OH, WA	CNCI, EMEC, UCRC, USNM, WSUC
<i>Nasonovia</i> (<i>Kakimia</i>) sp.		WA	WSUC
<i>Nearctaphis bakeri</i> Cowen	<i>Praon unicum</i> Smith	WA	WSUC
<i>Obtusicauda coweni</i> (Palmer)		WA	WSUC
<i>Ovatus crataegarius</i> (Walker) ?		WA	WSUC
<i>Paraphis juglandis</i> (Goeze)	<i>T. (Trioxys) pallidus</i> (Haliday)	WA	WSUC
<i>Periphyllus tyropictus</i> (Kessler)	<i>Euaphidius setiger</i> Mackauer	WA	WSUC
<i>P. negundinis</i> (Thomas)		NB	CNCI
<i>Phorodon humuli</i> (Schränk)	<i>Praon unicum</i> Smith	WA	WSUC
<i>Pleotrichophous</i> sp. ?		WA	WSUC
<i>Psylla pyricola</i> Förster ³		BC, ON	CNCI

Table 2. Continued.

Aphid or other Hosts	Associated Primary Hosts	Localities	Museum Acronyms
<i>Rhadobium porosus</i> (Sander-son)		NB	CNCI
<i>Rhopalomyzus (Judenkoa) lon-iceræ</i> (Siebold)	<i>Praon</i> sp.	WA	WSUC
<i>Rhopalosiphoninus (Myzosi-phon) solani</i> (Thomas)		NB	CNCI
<i>Rhopalosiphum</i> sp.		ON	CNCI
<i>R. cerasifoliae</i> (Fitch)	<i>Lysiphlebus (Phlebus) testaceipes</i> (Cresson)	WA	WSUC
<i>R. insertum</i> (Walker)	<i>Lysiphlebus (Phlebus) testaceipes</i> (Cresson); <i>Praon unicum</i> Smith	WA	WSUC
<i>R. maidis</i> Fitch	<i>Alloxysta</i> sp.	MN, WA	USNM, WSUC
<i>R. padi</i> (L.)	<i>Diaeretiella rapae</i> (M'Intosh); <i>Lysi-phlebus (Phlebus) testaceipes</i> (Cres-son)	WA	WSUC
<i>Schizaphis graminum</i> (Ron-dani)		IL, SK	CNCI, INHS
<i>Sipha (Rungsia) maydis</i> Pas-serini		ON	CNCI
<i>Siphocoryne</i> sp.		DC	USNM
<i>Sitobion avenae</i> (Fab.)	<i>Aphidius</i> sp.; <i>Diaeretiella rapae</i> (M'Intosh); <i>Praon</i> sp.	OR, WA	OSUC, WSUC
<i>Therioaphis trifolii</i> (Monell)	<i>Aphelinus semiflavus</i> Howard ¹	CA, WA	EMEC, WSUC
<i>Thripsaphis</i> sp.	<i>Praon</i> sp.	WA	WSUC
<i>Uroleucon</i> sp.	<i>Alloxysta</i> sp.; <i>Praon</i> sp.	WA	WSUC
<i>U. ambrosiae</i> (Thomas)	<i>Aphidius polygonaphis</i> Fitch ?	MD, ON	CNCI, USNM
<i>U. (Lambersiui) madia</i> Swain		NB, NJ, ON	CNCI, USNM
<i>U. souchi</i> (L.) ?		WA	WSUC
<i>Wahlgreniella nervata</i> (Gil-lette)	<i>Praon</i> sp.	WA	WSUC

¹ Chalcidoidea (Aphelinidae).

² From "egg mass", but likely some aphid with the egg mass.

³ Homoptera (Psyllidae).

or subeffaced net-like sculpture over bare area. Scutellum mostly bare except along extreme anterior and lateral margins (Fig. 47); frenum smooth and shiny except finely carinate laterally. Metapleuron bare (Fig. 65). Forewing with at least two rows of setae in basal cell (Fig. 69); disc with very narrow speculum, its dorsal surface with at least three setae close to submarginal vein (within distance equal to or less than length of setae) (Fig. 69). Petiole (Fig. 47) length at least slightly greater than width (up to about 1.25 times), and strongly carinate with reticulate or subeffaced sculpture between carinae.

Male.—Color pattern similar to female;

antenna rarely uniformly dark brown, much more commonly with flagellum and usually pedicel yellowish or at least distinctly lighter brown than dark scape. Scape (Figs. 39, 40) robust-subcylindrical, length about 4–5 times width, with dorsal and ventral margins subparallel, and usually with obscure linear or very narrow ventrally or externally angled, flat, microsetose sensory strip (Fig. 40a); inner surface low convex to flat, smooth, shiny and sparsely setose (Fig. 40b); outer surface (Fig. 40a) more distinctly convex. Combined length of pedicel and flagellum less than 2.5 times scape length and shorter than head width; funicle (Fig. 39) with all

segments at least slightly transverse. Setal pattern similar to female except metapleuron rarely with one short setae directed ventrally toward metacoxa. Structure similar to female, with petiole always at least slightly longer than wide (up to about 1.35 times) (Fig. 59).

Distribution.—A naturally occurring Holarctic species (see also under 'Remarks'). In North America distributed throughout the Nearctic region (Fig. 81) and extending south into Mexico. The absence of observed specimens from the states and provinces listed below undoubtedly reflects artifacts of collection (except possibly for Newfoundland and Labrador). **CANADA:** all territories and provinces except Yukon, and Newfoundland and Labrador. **USA:** all states except Alabama, Louisiana, New Jersey, North Dakota, Rhode Island, and Vermont. **EXTRALIMITAL.** *Neotropical:* **MEXICO** (CNCI). *Palearctic:* **AZORES** (USNM), **CANARY ISLANDS** (CNCI), **CZECH REPUBLIC** (CNCI), **DENMARK** (CNCI), **FINLAND** (CNCI, DAZH, VVPC), **FRANCE** (BMNH, CNCI, EMEC, UCRC, USNM), **GERMANY** (CNCI), **GREAT BRITAIN** (BMNH, EMEC), **HUNGARY** (CNCI), **ICELAND** (GNME, LUND, ZMCU), **IRAN** (ANIC, BMNH, CNCI, UCRC), **ISRAEL** (EMEC), **ITALY** (BMNH, CNCI, UCRC), **JAPAN** (CNCI, EMEC, UCRC, USNM), **SOUTH KOREA** (UCRC), **MADEIRA ISLANDS** (BMNH), ? **MOROCCO** (UCRC), **NETHERLANDS** (TAMU), **PEOPLE'S REPUBLIC OF CHINA** (CNCI, TAMU), **POLAND** (TAMU), **PORTUGAL** (BMNH), **SPAIN** (CNCI, UCRC), **SWEDEN** (BMNH, CNCI, MZLU), ? **TURKEY** (UCRC), **UKRAINE** (USNM). *Oriental:* **INDIA** (CNCI, UCRC), **NEPAL** (CNCI), **PAKISTAN** (UCRC).

Biology.—Specimens with host data from the Nearctic region indicate that *A. suspensus* is usually a hyperparasite of aphids through aphidiine and aphelinid primary parasites, and rarely also a parasite of *Psylla* (Homoptera: Psyllidae) (Ta-

ble 2). One record from a lepidopteran egg mass is undoubtedly erroneous.

Synonymy and type material examined.—*Asaphes suspensus* was generally considered to be a synonym of *A. vulgaris* until Graham (1969) reestablished the name as valid. Our synonymy of *A. rufipes* with *A. suspensus* is based on Graham's (1969) concept and examination of the holotype of *A. rufipes*. It is glued to a point and is entire, though the right wings are glued over the metasoma and the body is otherwise covered by a film of glue except for one antenna, about the dorsal half of the head and the dorsal surface of the mesosoma. The specimen is labelled as from "Boston Mass." rather than "Forest Hills," which was given in the original description, and has the additional labels "3671," "27315," "TYPE," "Asaphes rufipes Brues," "Holotype Asaphes rufipes Brues, V. Vikberg 1986," "Asaphes suspensus (Nees) det. V. Vikberg 1986."

The holotype female of *A. fletcheri* is point-mounted and entire. It has a hand written label with "Megorismus fletcheri Cwfd. ♀ type" and a red "Holotype" label. There are also 5 ♀ and 1 ♂ labelled as paratypes in the USNM as well as 5 ♀ labelled as paratypes in the CNCI. All specimens are labelled identically except for type labels. Because Crawford explicitly referred to 'paratypes' in the original description we consider the female labelled originally as 'Type' to be the holotype by original designation. The holotype is point-mounted and entire.

The type series of *A. americanus* consists of 4 ♀ and 1 ♂ syntypes on five slides. The Hampton female from experiment 102 is labelled as 'Type', the male from experiment 101 as 'Allotype', and the other three females as 'Paratypes'. However, in the original description Girault referred to all specimens as 'Types'. We hereby designate the Hampton female from experiment 101 as lectotype and the other four specimens as paralectotypes. The female originally labelled as type is not selected

as lectotype because the cover slip over the specimen is crushed.

Bouček et al. (1978) transferred *Pachycrepoides indicus* Bhatnager to *Asaphes* based on the original description and accompanying illustrations, and tentatively synonymized the name under *A. vulgaris* with the statement "judging from some points as e.g. head from above rectangular." We agree with the generic placement, but the original description states "Legs except the three coxae which are black, rest of legs are light yellowish-brown." This statement leads us to believe the name is a junior synonym of *A. suspensus*.

Remarks.—Females of *A. suspensus* are recognized by the combination of entirely yellowish legs and relatively narrow speculum with at least three setae very close to the submarginal vein (Fig. 69). Because of color variation, without associated males it is sometimes very difficult to distinguish females of *A. suspensus* and *A. californicus* in western North America. Males of *A. californicus* and *A. vulgaris* can have entirely yellowish legs, but structure of the scape distinguishes males of *A. californicus* and a broad speculum distinguishes males of *A. vulgaris*. Males of these last two species usually also have uniformly brown antennae (see under *A. californicus*).

Asaphes suspensus is undoubtedly widespread throughout the Palaearctic region from western Europe to Japan, much more so than is indicated by the relatively few countries listed above or in Graham (1969). Bakkendorf (1955), and probably based on him Graham (1969), reported *A. vulgaris* from Iceland. The junior author examined 3 females identified as *A. vulgaris* by Bakkendorf in 1955 (GNME), which were specimens of *A. suspensus*. *Asaphes suspensus* was also reported from southern Iceland and the Westman Islands by Lindroth et al. (1973). Because all specimens of *Asaphes* that we have seen from Iceland are *A. suspensus* it seems likely that this is the only species occurring in Iceland.

Farooqi and Subba Rao (1986) list *A. suspensus* from India and Pakistan, which we confirm. De Santis (1967, 1979) and De Santis and Fidalgo (1994) also recorded *A. suspensus* (as *A. lucens* and *A. rufipes*) within the Neotropical region as far south as Chile and Argentina. We saw specimens from La Plata and Jujuy, Argentina (MLPA) that were identified as *A. fletcheri* and *A. rufipes* by De Santis, but which fit within our concept of the *californicus*-complex. As discussed in the respective section for *A. californicus*, we suspect that most if not all records of *A. suspensus* south of Mexico result from misidentification of the *californicus*-complex.

***Asaphes vulgaris* Walker**
(Figs. 11, 12, 15, 29, 30, 41, 41, 48, 60, 70)

Asaphes vulgaris Walker 1834: 152. Both sexes described. Lectotype female designated by Graham 1969: 80–81; BMNH.

Eurytoma aenea Nees 1834: 42. Type data: Germany: Sickershausen, 11 June 1813. Female described. Holotype by monotypy, lost. Synonymy by Walker 1846: 23.

Chrysolampus aeneus Ratzeburg 1848: 185. Female described. Holotype by monotypy, ? lost (see Graham 1969: 81). Synonymy by Reinhard 1857: 76.

Chrysolampus aphidophila Rondani 1848: 21–22. Female described. Lectotype designated by Bouček 1974: 244; Museo Zoologico "La Specola," Florence, Italy. Synonymy by Bouček 1974: 244, 275.

Female.—Head and mesosoma dark with variedly distinct olive green metallic luster under some angles of light; legs mostly dark, at least middle and hind legs with trochanters infuscate to black [light-colored in some regions of western Europe] and femora black except apically, trochantelli often much lighter to yellowish, and tibia and tarsus usually yellowish. Head transverse-subtriangular in frontal view (Fig. 11), width at least 1.25 times height, and in lateral view lower face evenly curved into upper face (Fig. 12); interorbital region in dorsal view relatively

deeply concave (Fig. 15); gena length about 0.57–0.67 eye width and 0.5–0.6 eye length; dorsal margin of torulus approximately in line with lower orbit (Figs. 11, 12). Antenna (Figs. 29, 30) with pedicel length 1.65–2.3 times greatest width; funicle (Fig. 29) with fu_1 ring-like, fu_2 – fu_4 quadrate to transverse (Fig. 30), and fu_5 – fu_8 increasingly transverse. Mesoscutum (Fig. 48) with lateral lobes broadly bare medially, and with fine but distinct, engraved net-like sculpture over bare area. Scutellum mostly bare except along extreme anterior and lateral margins (Fig. 48); frenum smooth and shiny except finely carinate laterally. Metapleuron at most with one or two short setae directed ventrally toward metacoxa. Forewing with basal cell usually almost bare or with only single row of setae on dorsal surface (Fig. 70) except apically; disc with broad speculum, dorsal surface without setae near submarginal vein and with distance between basal setal line and first setal line on disc about equal to distance between first and fourth setal lines on disc (Fig. 70) (note: ventral surface of wing can have a few setae on bare band closer to submarginal vein). Petiole at least as long as and usually slightly longer than wide (up to 1.2 times), entirely or mostly reticulate with at most few irregular carinae (Fig. 48) to strongly carinate with subeffaced sculpture between carinae.

Male.—Color pattern similar to female except legs usually more extensively yellowish, with trochanters and trochantelli usually yellowish and often legs mostly or entirely yellow; antenna uniformly brown to black except possibly apex of pedicel and fu_1 lighter in color. Scape (Figs. 41, 42) elongate-subcylindrical or spindle-shaped, length about 5–6 times width, with dorsal and ventral margins subparallel; outer surface with shorter setae along line ventrally but without well defined microsetose area or smooth band (Fig. 42a); inner surface with sparse setae (Fig. 42b). Combined length of pedicel and flagellum less

than 2.5 times scape length and subequal in length to head width; funicle (Fig. 35) usually with all or most segments slightly to distinctly transverse, but at least fu_1 distinctly transverse, fu_2 transverse to quadrate, fu_3 and fu_4 transverse to slightly longer than wide, fu_5 and fu_6 transverse to quadrate, and fu_{7-8} distinctly transverse. Setal pattern and structure otherwise similar to female except petiole longer, length 1.25–1.60 times width (Fig. 60).

Distribution.—True world distribution is uncertain because of remaining taxonomic problems in differentiating the species (see under 'Remarks'). In North America *A. vulgaris* is restricted to eastern Canada and northeastern USA (Fig. 82). Based on this distribution and no collection records seen prior to 1953 it is probable that the species it is not naturally Holarctic but was introduced accidentally from Europe. Literature records from California and other western North American localities are based on misidentifications, probably mostly of *A. californicus*. At least some literature records from eastern North American localities are probably also based on misidentifications. **CANADA. Ontario:** Rondeau Provincial Park, 9–26.VI.80, H. Goulet (1 ♀). **Quebec:** Québec city, 27.VII.86, J. Brodeur, ex. *Aphidius nigripes* from *Macrosiphum euphorbiae* (1 ♀, 2 ♂). **Nova Scotia:** Aylesford, 24.VII.63, H. Specht, host *Acyrtosiphum pisum* (1 ♀). Centerville, 15.VIII, 9.IX.63, R. Foley, (4 ♀, 1 ♂); Coldbrook, 30.IX., 7, 10, 16, 21.X.63 (6 ♀, 3 ♂), Coldwell near Canard, 8, 23.VIII.63 (1 ♀, 1 ♂), Garland, 6.VIII.63 (1 ♂), Picketts Wharf near Canard, 2.VII.63 (2 ♀, 1 ♂)—all H. B. Specht, host *Acyrtosiphum pisum* (Harris) on alfalfa or clover. Kentville, greenhouse, 28.II.68, H.B. Specht, host pea aphid (1 ♂). Lockport, 20.VII.58, J.R. Vockeroth (1 ♀). **Prince Edward Island:** N Tryon, 26.VI.91, M.E.M. Smith, in potato field (1 ♀, 1 ♂). **USA. Maine:** Aroostook Co., 1953, ex. *Macrosiphum solanifolii* (4 ♀, 3 ♂). **Massachusetts:** Amherst, Nadel, clover (1 ♀, USNM). EX-

TRALIMITAL. *Palearctic*: AUSTRIA (CNCI), CZECH REPUBLIC (CNCI, UCRC), DENMARK (CNCI), FINLAND (DAZH, VVPC), FRANCE (CNCI, EMEC, UCRC, USNM), GERMANY (BMNH, CNCI, USNM), GREAT BRITAIN (ANIC, BMNH, CNCI, EMEC, USNM), GREECE (CNCI, TAMU, UCRC), IRELAND (CNCI), ISRAEL (UCRC, USNM), ITALY (CNCI, UCRC, USNM), LEBANON (UCRC), MOROCCO (UCRC), SPAIN (CNCI, UCDC, UCRC), SWEDEN (BMNH, CNCI, MZLU), TURKEY (UCRC, USNM). *Afrotropical*: ? ERITREA (UCRC), ? ETHIOPIA (CNCI), ? SOUTH AFRICA (CNCI, USNM), ? ZIMBABWE (CNCI). *Australian*: AUSTRALIA (Tasmania) (ANIC, BMNH), NEW ZEALAND (CNCI, EMEC).

Biology.—Host records based on examined specimens indicate that in North America *A. vulgaris* is a hyperparasite of aphids, including *Acyrtosiphon pisum* (Harris) and *Macrosiphum euphorbiae* (Thomas) through aphidiines, including *Aphidius nigripes* (Ashmead). Most of the unsubstantiated aphid host records from western North American localities given in Peck (1963) likely refer to *A. californicus*, whereas non-aphid hosts other than Syrphidae likely are erroneous.

Remarks.—Females of *A. vulgaris* are distinguished by a combination of features, but primarily by their broad, distinct speculum (Fig. 70), dark trochanters (at least in the Nearctic region), and relatively deeply concave interorbital region (Fig. 15). Females of *A. californicus* with a broad speculum could be confused with *A. vulgaris* females, but ranges of the two species apparently do not overlap in the New World (Fig. 82). Further, Nearctic *A. californicus* females have more or less uniformly light-colored trochanters and trochantelli, whereas the trochanters and trochantelli are dark in *A. vulgaris* or at least the trochanters are distinctly darker than the trochantelli, more similar in color to the femora. Some females of *A. vulgaris* from western Europe have both the tro-

chanters and trochantelli yellowish in distinct contrast to dark femora, but their broad speculum readily differentiates these from other known species in western Europe. All specimens tentatively identified as *A. vulgaris* from the Afrotropical region also have yellow trochanters and trochantelli plus a broad speculum. Only one male was seen from Zimbabwe but a series of both sexes were seen from Ethiopia, Eritrea and South Africa. The African males have scapes with a variedly distinct, flat, densely setose, sometimes laterally margined ventral surface. The scapes of most specimens are also distinctly shorter and more robust (more similar to *A. suspensus*, cf. Fig. 39) than the relatively elongate-slender, shinier, and much more sparsely setose scape of *A. vulgaris* males from North America or Europe (Fig. 41). Further, both sexes of the African specimens appear to have the interorbital region more shallowly concave (cf. Figs. 16, 17 with Fig. 15), though this feature is variable and difficult to quantify. Only females were seen from Lebanon and Morocco. The Afrotropical specimens are tentatively identified as *A. vulgaris* for the purposes of this study, but a comprehensive study of *Asaphes* is required from throughout the Palearctic region and Africa to determine character variation and species limits. It is very possible that specimens with dark femora and yellowish trochanters and trochantelli from at least the Afrotropical region of Africa belong to an undescribed species different from *A. vulgaris*.

Males of *A. vulgaris*, particularly from regions outside of the Nearctic, can have the legs entirely yellow but are differentiated from males of *A. suspensus* by their broad speculum and longer scape (cf. Figs. 39, 40), though the range of variation is greater than stated by Graham (1969) and the shortest scape of *A. vulgaris* males is similar in relative length to the longest *A. suspensus* scape. Separation from males of

other species is discussed under the respective section for these species.

De Santis (1967, 1979, 1980) listed *A. vulgaris* from San Vicente, Juan Fernández, Argentina, Brazil, and Chile. We saw specimens from La Plata (♀, ♂) and Jujuy (♀), Argentina (MLPA) that were identified by De Santis as *A. vulgaris*, and these fit within our concept of the *californicus*-complex from South America. We have not seen any specimen from the Neotropical region that we identify as *A. vulgaris* (see 'Remarks' for *A. californicus*) and it is likely that most or all records of *A. vulgaris* from South America are based on misidentifications (see also 'Remarks' for *A. suspensus*). Records of *A. vulgaris* from Greenland may also be based on misidentifications of *A. hirsutus* (see 'Remarks' for *A. hirsutus*).

Nomina inquirenda

Parectroma hübrichi Brèthes 1913: 91–92. Type data: Argentina: Rosario (J. Hübrich) and Buenos Aires (A. Zotta). Female described. Syntypes [Rosario female examined]; MLPA. Synonymized with *A. fletcheri* by De Santis 1960: 114.

Pachycrepoides bonariensis Brèthes 1916: 427. Type data: Argentina: Buenos Aires, 5.XI. 1915. Female described. Holotype by monotypy. Synonymized with *A. lucens* by De Santis 1967: 189.

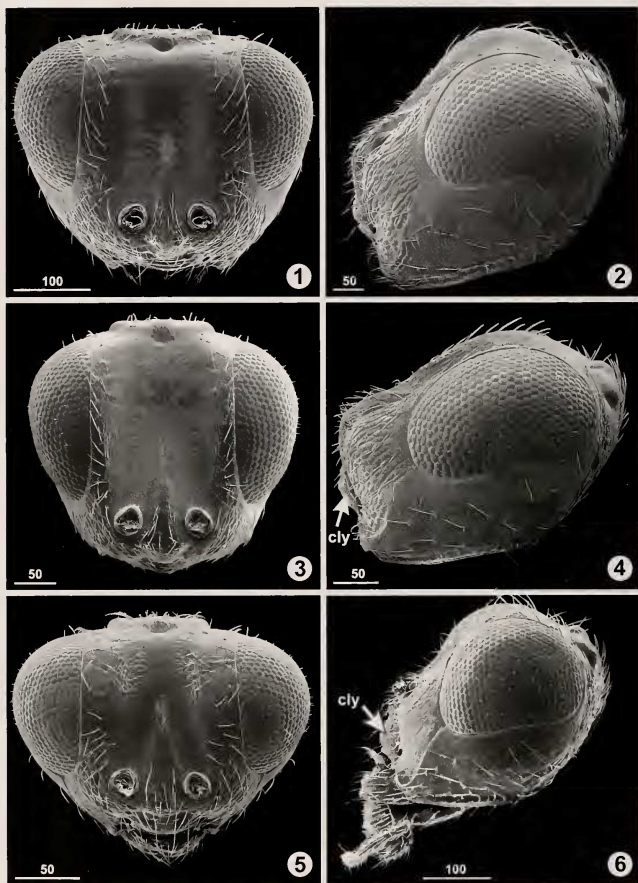
Remarks.—De Santis (1960, 1967) synonymized, respectively, *A. huebrichi* (Brèthes, 1913) under *A. fletcheri* (Crawford, 1909) and *A. bonariensis* (Brèthes, 1916) under *A. lucens* (Provancher, 1887). Burks (1964) synonymized *A. fletcheri* under *A. lucens*, which in this paper we synonymize under *A. suspensus* (Nees, 1834). We examined the 'Rosario' female syntype of *A. huebrichi*. It is mounted laterally on a slide, is crushed, and otherwise is poorly preserved. The petiole is quadrate, although this appearance may partly be because it is flattened somewhat by the cover slip. The specimen also has uniformly yellowish legs, which led De Santis to synony-

mize the name under *A. fletcheri*. However, one forewing remains attached and although it lies over the hind wing a broad speculum is visible. Because of the absence of a row of setae immediately behind the submarginal vein on the disc we do not consider that *A. huebrichi* is synonymous with *A. suspensus*. The specimen has brownish coxae, a feature that we have observed only in some females from South America with uniformly yellowish legs and a broad speculum, which we currently include in the *californicus*-complex from South America (see 'Remarks' for *A. californicus*). At this time we do not formally synonymize the names *A. huebrichi*, *A. bonariensis*, and *A. californicus*. Formal synonymy of either *A. huebrichi* (1913) or *A. bonariensis* (1916) with *A. californicus* (1917) would result in *A. californicus* becoming the junior synonym. Our study of Neotropical material has been insufficient to confidently resolve the limits of variation and number of species of *Asaphes* occurring in the Neotropical region. For reasons of stability we do not consider it appropriate to make formal nomenclatural changes until concepts of species are better resolved and topotypic material of *A. huebrichi* and *A. bonariensis* can be studied. For this reason we treat these names as *nomina inquirenda*.

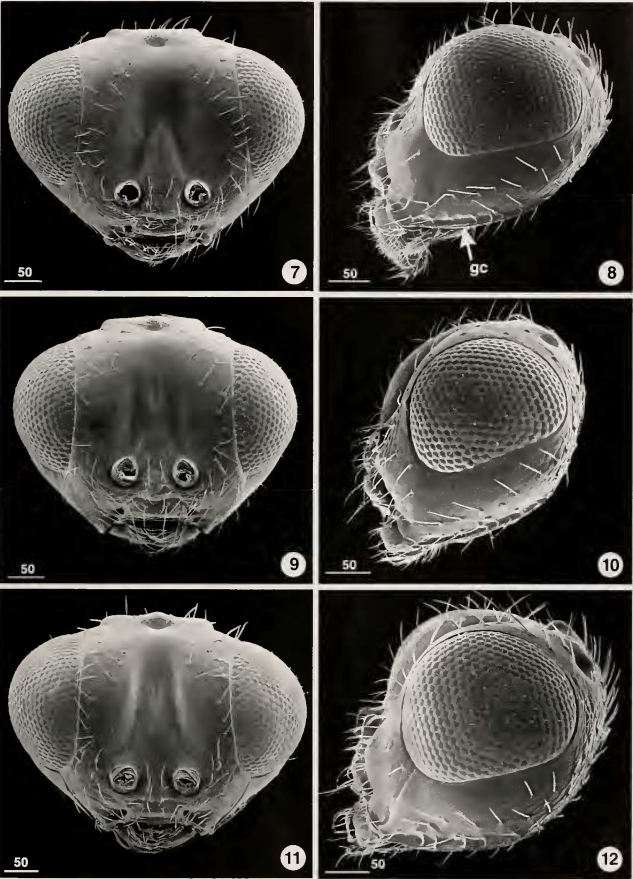
ACKNOWLEDGMENTS

We thank Drs. J. Huber and H. Goulet, Eastern Cereal and Oilseed Research Centre (ECORC) for critically reviewing this manuscript; Mr. K. Bolte (Canadian Forest Service) prepared the specimens for SEM and produced the micrographs, Ms. Inna Nei prepared the distribution maps; and Ms. J. Read (ECORC) produced the plates of illustrations. We thank Dr. K. Kamijo, Hokkaido Forest Experiment Station, Japan, for the gift of representatives of both Japanese species. The following collections and curators also provided specimens for this study:

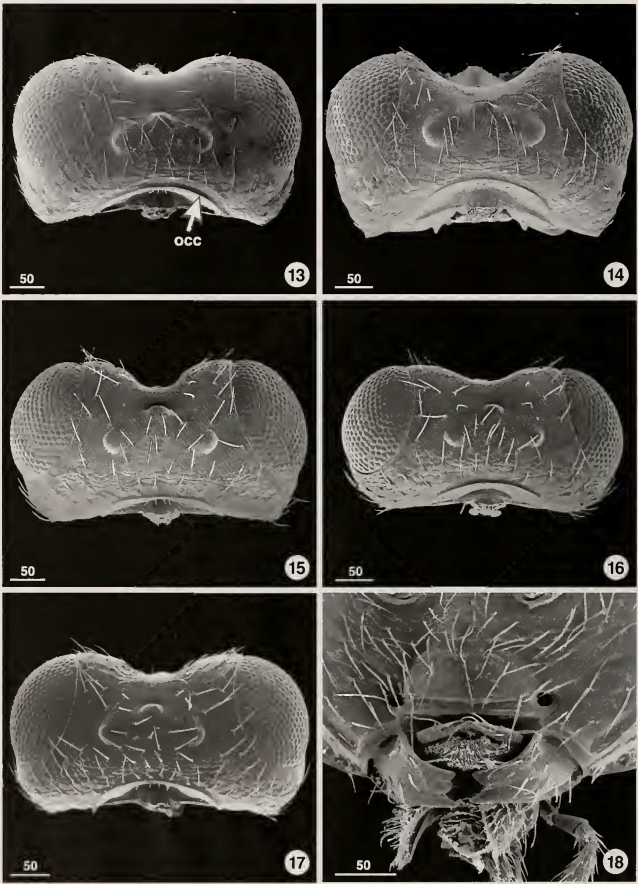
AEIC	American Entomological Institute, Gainesville, FL (D. Wahl).
ANIC	Australian National Insect Collection, CSIRO, Canberra City, Australia (I. Naumann).
AFRC	Atlantic Forestry Research Centre, Canadi-



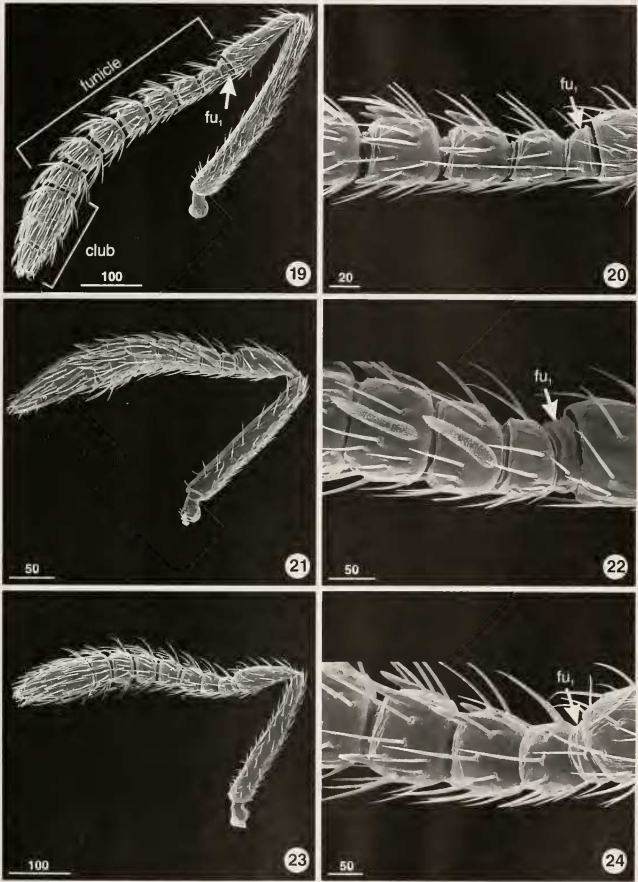
Figs. 1-6. Head: 1 and 2, *Asaphes brevipetiolatus* (♀); 3 and 4, *A. brevipetiolatus* (♂); 5 and 6, *A. hirsutus* (♀). (abbreviation: cly = clypeus; scale bars = microns)



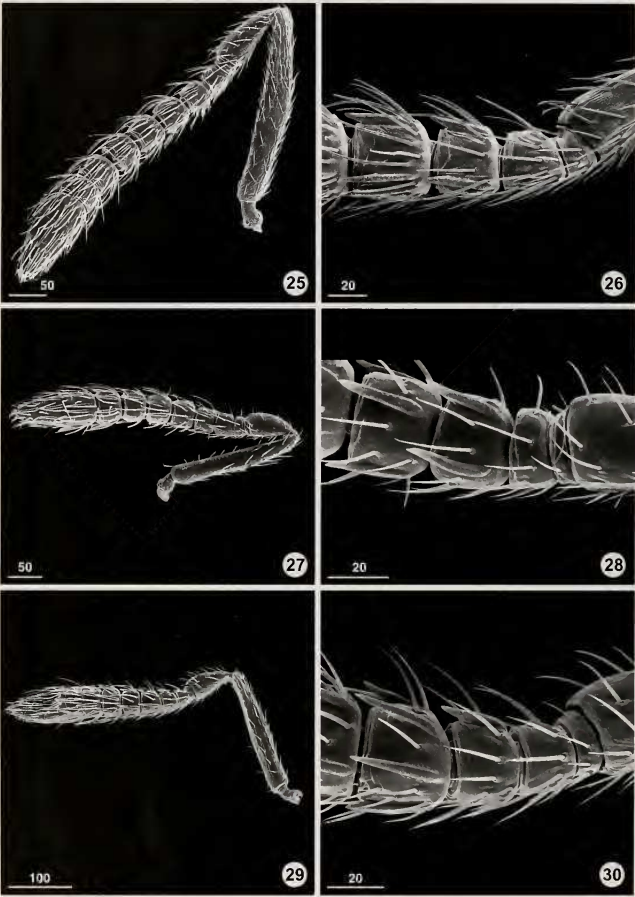
Figs. 7–12. Head (♀): 7 and 8, *Asaphes californicus*; 9 and 10, *A. suspensus*; 11 and 12, *A. vulgaris*. (abbreviation: gc = genal carina; scale bars = microns)



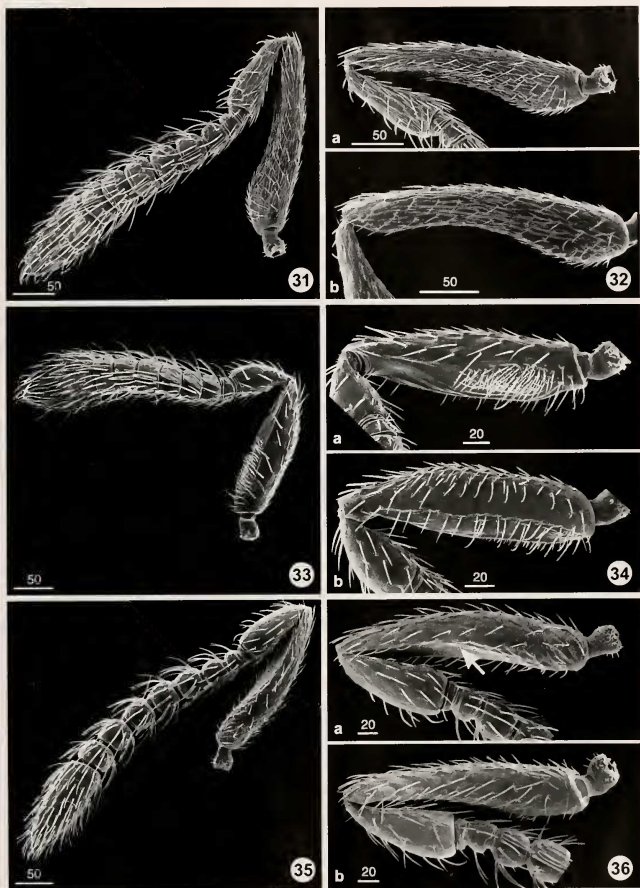
Figs. 13–18. 13–17. Head, dorsal: 13, *Asaphes brevipetiolatus* (♀); 14, *A. brevipetiolatus* (♂); 15, *A. vulgaris* (♀); 16, *A. suspensus* (♀); 17, *A. hirsutus* (♀). 18. Clypeus and mandibles, *A. hirsutus* (♀). (abbreviation: occ = occipital carina; scale bars = microns)



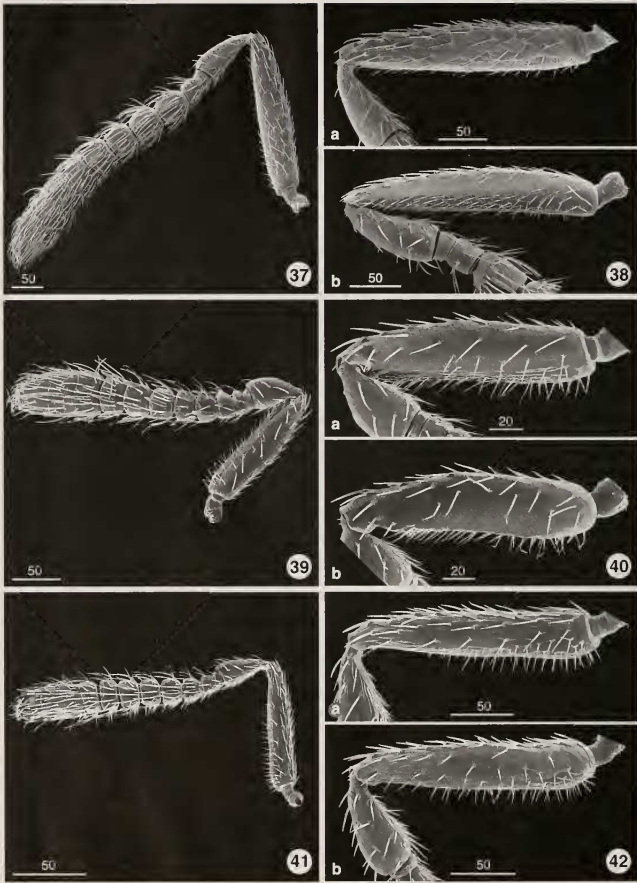
Figs. 19–24. 19 and 20. *Asaphes brevipetiolatus* (♀): 19, antenna; 20, basal 4 flagellar segments. 21 and 22. *A. californicus* (♀): 21, antenna; 22, basal 4 flagellar segments. 23 and 24. *A. hirsutus* (♀): 23, antenna; 24, basal 4 flagellar segments. (abbreviation: fu₁ = first funicular segment; scale bars = microns)



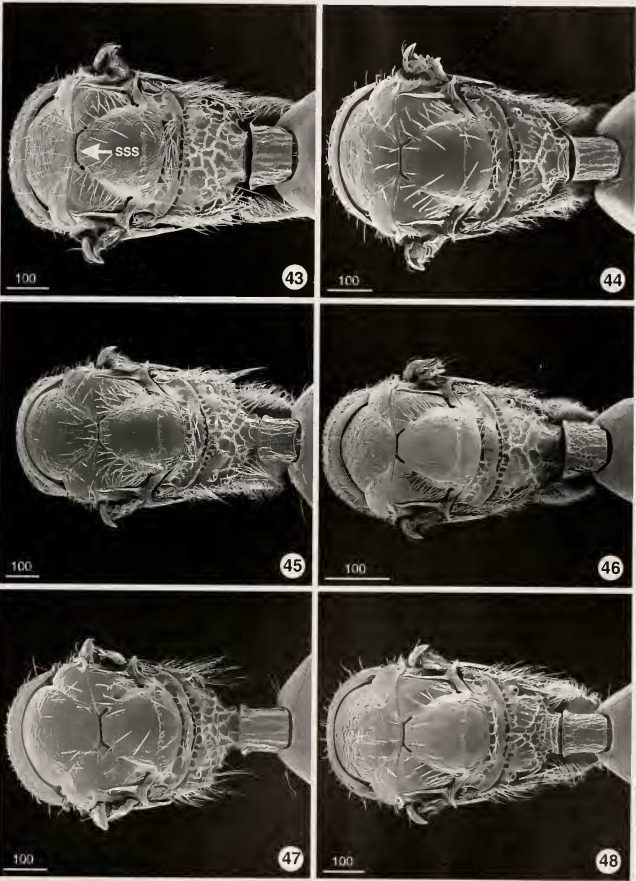
Figs. 25-30. 25 and 26. *Asaphes petiolatus* (♀): 25, antenna; 26, basal 4 flagellar segments. 27 and 28. *A. suspensus* (♀): 27, antenna; 28, basal 4 flagellar segments. 29 and 30. *A. vulgaris* (♀): 29, antenna; 30, basal 4 flagellar segments. (scale bars = microns)



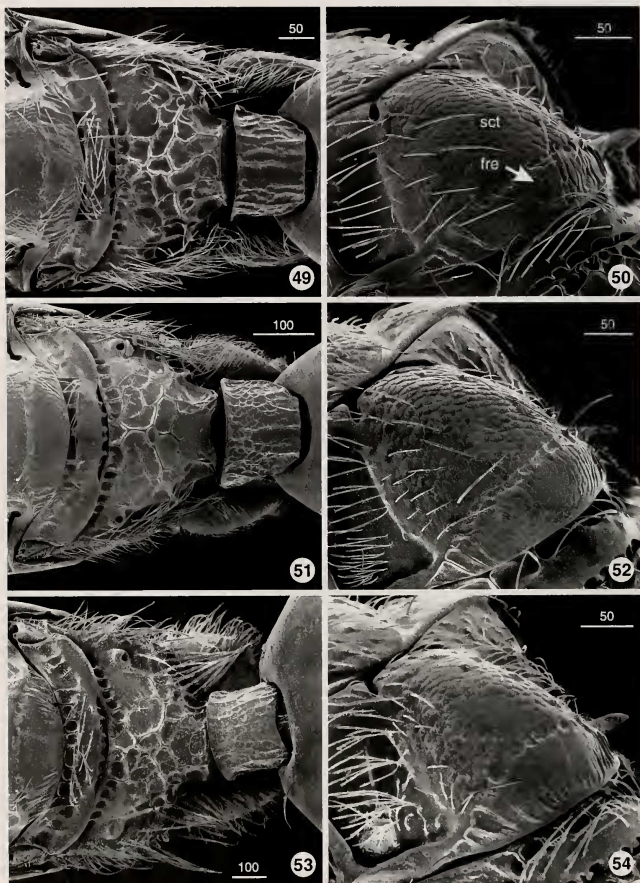
Figs. 31–36. 31 and 32. *Asaphes brevipetiolatus* (♂): 31, antenna; 32, scape—a, outer view, b, inner view. 33 and 34. *A. californicus* (♂): 33, antenna; 34, scape—a, outer view, b, inner view. 35 and 36. *A. hirsutus* (♂): 35, antenna; 36, scape—a, outer view (arrow points to flat surface), b, inner view. (scale bars = microns)



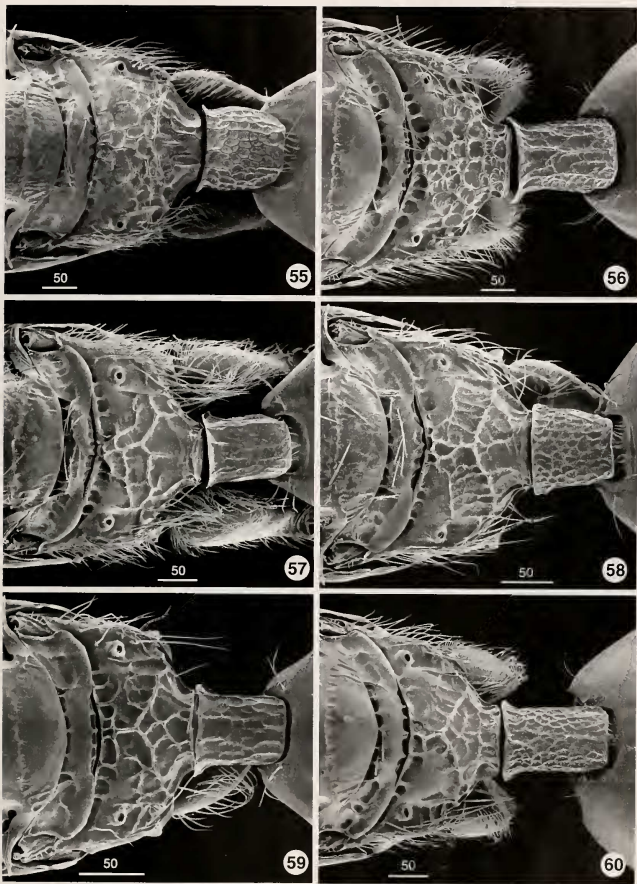
Figs. 37–42. 37 and 38. *Asaphes petiolatus* (δ): 37, antenna; 38, scape—a, outer view, b, inner view. 39 and 40. *A. suspensus* (δ): 39, antenna; 40, scape—a, outer view, b, inner view. 41 and 42. *A. vulgaris* (δ): 41, antenna; 42, scape—a, outer view, b, inner view. (scale bars = microns)



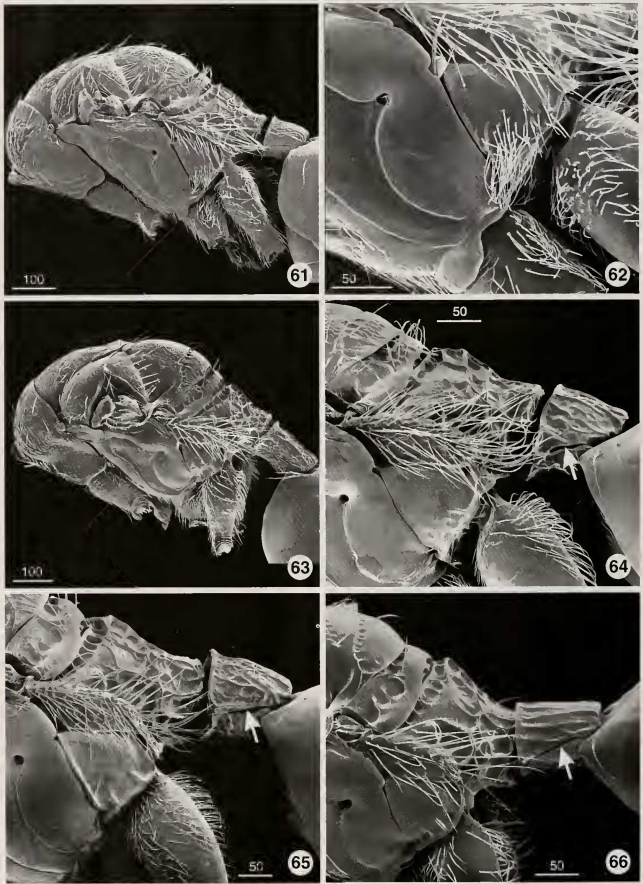
Figs. 43–48. Mesosoma, dorsal (♀). 43, *Asaphes brevipetiolatus*; 44, *A. californicus*; 45, *A. hirsutus*; 46, *A. petiolatus*; 47, *A. suspensus*; 48, *A. vulgaris*. (abbreviation: sss = scutoscuteellar suture; scale bars = microns)



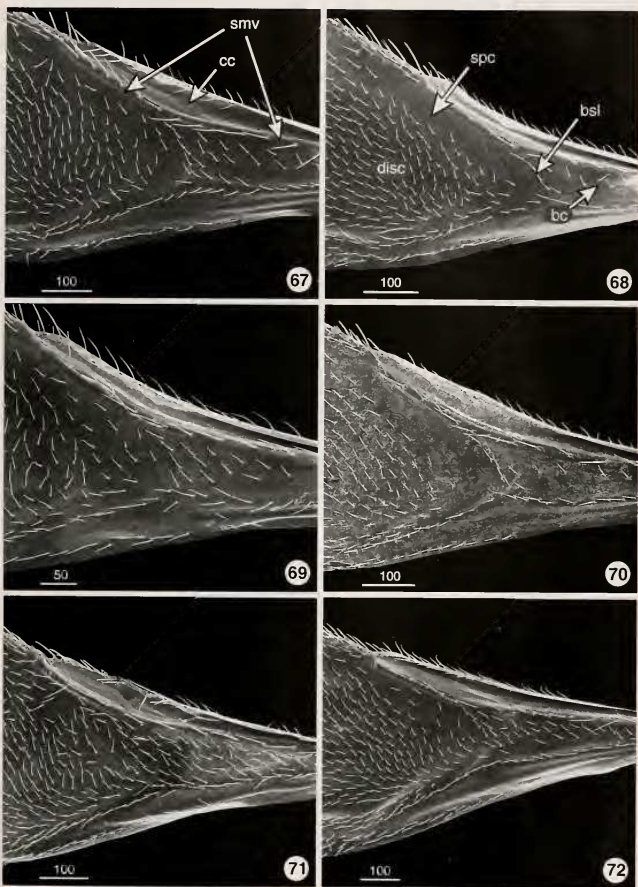
Figs. 49–54. 49 and 50. *Asaphes brevipetiolatus* (♀): 49, frenum to petiole; 50, sculpture of scutellum and frenum. 51 and 52. *A. petiolatus* (♀): 51, frenum to petiole; 52, sculpture of scutellum and frenum. 53 and 54. *A. hirsutus* (♀): 53, frenum to petiole; 54, sculpture of scutellum and frenum. (abbreviations: fre = frenum, sct = scutellum; scale bars = microns)



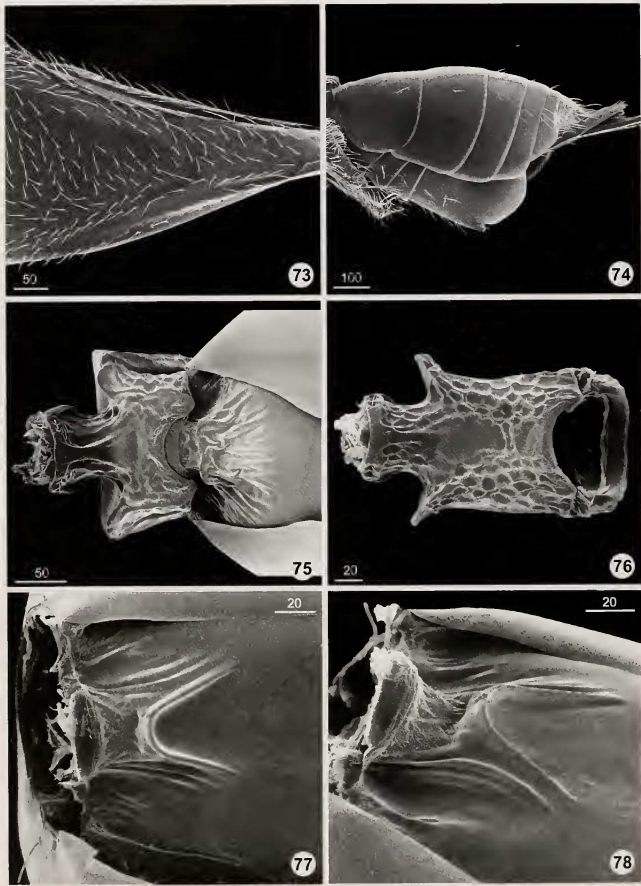
Figs. 55-60. Frenum to petiole (δ): 55, *A. brevipetiolatus*; 56, *A. californicus*; 57, *A. hirsutus*; 58, *A. petiolatus*; 59, *A. suspensus*; 60, *A. vulgaris*. (scale bars = microns)



Figs. 61-66. 61 and 62. *Asaphes hirsutus*: 61, lateral mesosoma (♀); 62, metapleuron (♂). 63. *A. californicus*: lateral mesosoma (♂). 64-66. Metathorax to petiole, lateral (♀) (arrow points to lateral sulcus of petiole): 64, *A. brevipetiolatus*; 65, *A. petiolatus*; 66, *A. suspensus*. (scale bars = microns)



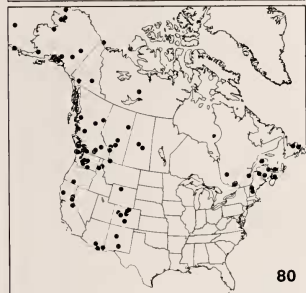
Figs. 67-72. Forewing (♀): 67 and 68, *Asaphes californicus*; 69, *A. suspensus*; 70, *A. vulgaris*; 71, *A. hirsutus*; 72, *A. petiolatus*. (abbreviations: bc = basal cell, bsl = basal setal line, cc = costal cell, smv = submarginal vein, spc = speculum; scale bars = microns)



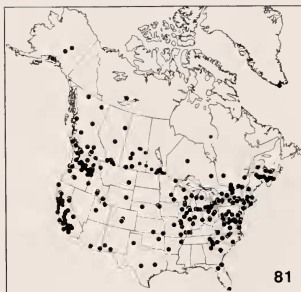
Figs. 73-78. 73. Forewing: *Asaphes brevipetiolatus* (♀). 74. Gaster: *A. hirsutus* (♀). 75. Petiole and base of gaster, ventral view: *A. petiolatus* (♀). 76. Petiole, ventral view: *A. californicus* (♀). 77 and 78. *A. suspensus*, base of gaster (♀): 77, ventral view; 78, ventrolateral view. (scale bars = microns)



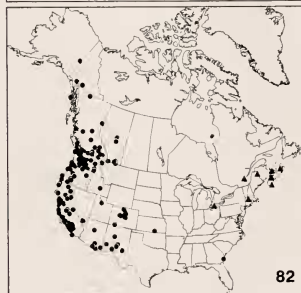
79



80



81



82

Figs. 79–80. Nearctic distribution: 79, *Asaphes brevipetiolatus* (●) and *Asaphes petiolatus* (▲). 80, *Asaphes hirsutus*.

Figs. 81–82. Nearctic distribution: 81, *Asaphes suspensus*. 82, *Asaphes californicus* (●) and *A. vulgaris* (▲).

- an Forest Service, Insect Collection, St. John's, NF (G. Smith).
- BMNH The Natural History Museum, London, England (J. Noyes, Z. Bouček).
- CASC California Academy of Sciences, Department of Entomology, San Francisco, CA (D. Ubick, W. Pulawski).
- CISC California Insect Survey, Division of Entomology and Parasitology, University of California, Berkeley, CA (R. Zuparko).
- CNCI Canadian National Collection of Insects and Arachnids, Ottawa, ON.
- CUIC Cornell University Insect Collection, Department of Entomology, Cornell University, Ithaca, NY (E. R. Hoebeke).
- DAZH Department of Applied Zoology, University of Helsinki, Helsinki, Finland (M. Koponen).

- DCPC Dominique Collet private collection, Sterling, AK (D. Collet).
- EDUM Department of Entomology, University of Manitoba, Winnipeg, MB (T. Galloway).
- EMEC Essig Museum of Entomology, University of California, Berkeley, CA (R. Zuparko).
- GNME Department of Entomology, Naturhistoriska Museet, Göteborg, Sweden (G. Andersson).
- HAPC Harry Anderson Private Collection, Huntington Beach, CA (H. Anderson).
- INHS Illinois Natural History Survey Insect Collection, Champaign, IL (K.R. Zeiders).
- MLPA Museo de la Plata, Universidad Nacional de La Plata, División Entomología, La Plata, Argentina (L. De Santis).

- MZLU Museum of Zoology, Lund University, Lund, Sweden (R. Danielsson, U. Gårdenfors).
- NFRC Northern Forest Research Centre, Canadian Forest Service, Edmonton, AB (D. Williams).
- PFRC Pacific Forestry Research Centre, Canadian Forest Service, Victoria, BC (L. Humble).
- OSUC Collection of Insects and Spiders, Ohio State University, Columbus, OH (A. Sharikov).
- OSUO Department of Entomology Collection, Oregon State University, Corvallis, OR (D.C. Darling).
- SMDV Spencer Museum, Department of Zoology, University of British Columbia, Vancouver, BC (K. Needham).
- TAMU Department of Entomology, Texas A&M University, College Station, TX (J. Woolley, E. Riley).
- UCDC The Bohart Museum, University of California, Davis, CA (S. Heydon).
- UCRC UCR Entomological Training and Research Collection, University of California, Riverside, CA (S. Triapitsyn).
- USNM United States National Entomological Collection, U.S. National Museum of Natural History, Washington, DC (E.E. Grissell).
- UZMH Zoological Museum, University of Helsinki, Helsinki, Finland (A. Albrecht, M. Koponen).
- VVPC Veli Vikberg personal collection, Turenki, Finland (V. Vikberg).
- WSUC James Entomological Collection, Department of Entomology Collection, Washington State University, Pullman, WA (K.S. Pike), and Tree Fruit Research Center, Washington State University, Wenatchee, WA (D. Carroll).
- ZMAS Zoological Museum, Academy of Sciences, Saint Petersburg, Russia (V.A. Trjapitzin).
- ZMUC Zoological Museum, University of Copenhagen, Copenhagen, Denmark (B. Petersen).
- Bhatnager, S. P. 1951. Descriptions of new and records of known Chalcidoidea (Parasitic Hymenoptera) from India. *Indian Journal of Agricultural Science* 21: 155-178.
- Bocchino, F. J. and D. J. Sullivan, S.J. 1981. Effects of venoms from two aphid hyperparasitoids, *Asaphes lucens* and *Dendrocerus carpenteri* (Hymenoptera: Pteromalidae and Megaspilidae), on larvae of *Aphidius smithi* (Hymenoptera: Aphidiidae). *Canadian Entomologist* 113: 887-889.
- Bolte, K. B. 1996. Techniques for obtaining scanning electron micrographs of minute arthropods. *Proceedings of the Entomological Society of Ontario* 127: 67-87.
- Bouček, Z. 1974. On the Chalcidoidea (Hymenoptera) described by C. Rondani. *Redia* 55: 241-285.
- Bouček, Z. 1976. African Pteromalidae (Hymenoptera): new taxa, synonymies and combinations. *Journal of the Entomological Society of Southern Africa* 39: 9-31.
- Bouček, Z. 1988. *Australasian Chalcidoidea (Hymenoptera). A biosystematic revision of genera of fourteen families, with a reclassification of species.* CAB International, Wallingford. 832 pp.
- Bouček, Z. and S. L. Heydon. 1997. Chapter 17. Pteromalidae. Pages 541-692 in Gibson, G. A. P., J. T. Huber, and J. B. Woolley (eds). *Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)*. National Research Council Canada, Research Press, Ottawa. 794 pp.
- Bouček, Z. and J.-Y. Rasplus. 1991. *Illustrated key to West-Palearctic genera of Pteromalidae (Hymenoptera: Chalcidoidea)*. Institut National de la Recherche Agronomique, Paris. 140 pp.
- Bouček, Z., B. R. Subba Rao, and S. I. Farooqi. 1978. A preliminary review of Pteromalidae (Hymenoptera) of India and adjacent countries. *Oriental Insects* 12: 433-468.
- Brèthes, J. 1913. Himenópteros de la América Meridional. *Anales del Museo Nacional de Historia Natural de Buenos Aires* 24: 35-166.
- Brèthes, J. 1916. Himenóptères parasites de l'Amérique Méridionale. *Anales del Museo Nacional de Historia Natural de Buenos Aires* 27: 401-430.
- Brown, N. R. and R. C. Clark. 1960. Studies of predators of the balsam woolly aphid, *Adelges picea* (Ratz.) (Homoptera: Adelgidae). VIII. Syrphidae (Diptera). *Canadian Entomologist* 92: 801-811.
- Brues, C. T. 1908. Notes and descriptions of North American parasitic Hymenoptera. VII. *Bulletin of the Wisconsin Natural History Society* 6: 160-163.
- Burks, B. D. 1958. Superfamily Chalcidoidea. Pages 62-84 in Krombein, K. V. (ed.). *Hymenoptera of America North of Mexico. Synoptic Catalog*. United States Department of Agriculture, Agricultural Monograph No. 2, First Supplement. Washington, D.C., U.S. Government Printing Office. 305 pp.
- Burks, B. D. 1964 (1963). The Provancher species of

LITERATURE CITED

- Ashmead, W. H. 1904. Classification of the chalcid flies of the superfamily Chalcidoidea, with descriptions of new species in the Carnegie Museum, collected in South America by Herbert H. Smith. *Memoirs of the Carnegie Museum* 1: i-ix + 225-551.
- Bakkendorf, O. 1955. Notes on Icelandic and Greenlandic Chalcidoidea Hymenoptera. *Entomologiske Meddelelser* 27: 135-162.
- Batulla, B. A. and A. G. Robinson. 1985(1984). Hymenopterous parasitoids of aphids (Homoptera: Aphididae) in Manitoba. *Proceedings of the Entomological Society of Manitoba* 40: 30-38.

- Chalcidoidea (Hymenoptera). *Canadian Entomologist* 95: 1254-1263.
- Burks, B. D. 1979. Family Pteromalidae. Pages 768-835 in Krombein, K. V., P. D. Hurd, Jr., D. R. Smith, and B. D. Burks (eds). *Catalog of Hymenoptera in America North of Mexico. Vol. 1. Symphyta and Apocrita (Parasitica)*. Smithsonian Institution Press, Washington, D.C. i-xvi, 1-1198.
- Carew, W. P. and D. J. Sullivan. 1993. Interspecific parasitism between two aphid hyperparasitoids, *Dendrocerus carpenteri* (Hymenoptera: Megaspilidae) and *Asaphes lucens* (Hymenoptera: Pteromalidae). *Annals of the Entomological Society of America* 86: 794-798.
- Crawford, J. C. 1909. Notes on some Chalcidoidea. *Canadian Entomologist* 41: 98-99.
- Curtis, J. 1842. Observations on the natural history and economy of various insects affecting the turnip-crops; including the plant-lice, maggots of flies, caterpillars of moths, etc. *Journal of the Royal Agricultural Society of England* 3: 49-78.
- Dahlbom, A. G. 1857. Svenska Sma-Ichneumonernas familjer och släkten. *Kongliga Svenska Vetenskapsakademiens Handlingar* 14: 289-298.
- Dahms, E. C. 1978. A checklist of the types of Australian Hymenoptera described by Alexandre Arsené Girault: 1. Introduction, acknowledgments, biography, bibliography and localities. *Memoirs of the Queensland Museum* 19: 127-190.
- Delucchi, V. 1955. Notes sur les Pteromalides (Hym., Chalcidoidea). *Mémoires de la Société royale belge d'Entomologie* 27: 171-175.
- De Santis, L. 1960. Anotaciones sobre Calcidoideos Argentinos. II. (Hymenoptera). *Revista de la Facultad de Agronomía (3a época)* 36: 109-119.
- De Santis, L. 1967. *Catálogo de los Himenópteros Argentinos de la Serie Parasítica, Incluyendo Bethyloidea*. Provincia de Buenos Aires Gobernación, Comisión de Investigación Científica, La Plata. 337 pp.
- De Santis, L. 1979. *Catálogo de los Himenópteros Chalcidoideos de América al sur de los Estados Unidos*. Comisión de Investigaciones Científicas de la Provincia de Buenos Aires, Publicación Especial, La Plata. 488 pp.
- De Santis, L. 1980. *Catálogo de los Himenópteros Brasileños de la Serie Parasítica Incluyendo Bethyloidea*. Editora da Universidade Federal do Paraná, Curitiba. 395 pp.
- De Santis, L. and P. Fidalgo. 1994. *Catálogo de Himenópteros Chalcidoideos. Serie de la Academia nacional de Agronomía y Veterinaria* 13: 1-154.
- Dzhanokmen, K. A. 1987. 5. Family Pteromalidae (pteromalids). Pages 88-411 in Medvedev, G. S. (editor-in-chief). *Keys to the insects of the European part of the USSR. Vol. III. Hymenoptera. Part II. Amerind Publishing. Pvt. Ltd., New Delhi*. i-xii + 1341 pp. [English translation of Medvedev, G. S. (editor-in-chief). 1978. *Handbook of the Insects of the European Part of the U.S.S.R. Vol. III. Hymenoptera, Second part*. Leningrad, Nauka (in Russian)].
- Eastop, V. F. and D. Hille Ris Lambers. 1976. *Survey of the world's aphids*. Dr. W. Junk b.v., The Hague. 573 pp.
- Farooqi, S. I. and B. R. Subba Rao. 1986. Family Pteromalidae. Pages 279-306 in Subba Rao, B. R. and M. Hayat (eds). *The Chalcidoidea (Insecta: Hymenoptera) of India and the adjacent countries*. *Oriental Insects* 20: 1-430.
- Förster, A. 1856. *Hymenopterologische Studien. II. Heft. Chalcidiae und Proctotrupii*. Aachen. 152 pp.
- Gahan, A. B. and M. M. Fagan. 1923. The type species of the genera of Chalcidoidea or chalcid-flies. *Bulletin of the United States National Museum* 124: 1-173.
- Gahan, A. B. and S. A. Rowher. 1917. Lectotypes of the species of Hymenoptera (except Apoidea) described by Abbé Provancher. *Canadian Entomologist* 49: 391-400.
- Gärdenfors, U. 1986. Taxonomic and biological revision of Palearctic *Ephedrus* Haliday (Hymenoptera: Braconidae, Aphidiinae). *Entomologica Scandinavica Supplement* 27: 1-95.
- Gibson, G. A. P. 1997. Chapter 2. Morphology and Terminology. Pages 16-44 in Gibson, G. A. P., J. T. Huber, and J. B. Woolley (eds). *Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)*. National Research Council Canada, Research Press, Ottawa. 794 pp.
- Girault, A. A. 1914[219]. Descriptions of new chalcid-flies. *Proceedings of the Entomological Society of Washington* 16: 109-119.
- Girault, A. A. 1917[330]. *Descriptiones Hymenopterorum Chalcidicarum variorum cum observationibus* V. Private publication, Glendale. 16 pp.
- Goulet, H. and W. R. M. Mason. 1993. Chapter 4. Use of keys. Pages 60-64 in Goulet, H. and J. T. Huber (eds). *Hymenoptera of the world: An identification guide to families*. Research Branch, Agriculture Canada Publication 1894/E, Ottawa. 668 pp.
- Graham, M. W. R. de V. 1969. The Pteromalidae of North-Western Europe (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum (Natural History)*, Entomology 16: 1-908.
- Graham, M. W. R. de V. 1990. The identity of certain problematic Dahlbom genera of Chalcidoidea (Hym.), some represented by original material in Zoologiska Institutionen, Lund. *Entomologist's Monthly Magazine* 126(1516-1519): 197-200.
- Griswold, G. H. 1929. On the bionomics of a primary parasite and of two hyperparasites of the geranium aphid. *Annals of the Entomological Society of America* 22: 438-457.
- Hagen, K. S. and R. van den Bosch. 1968. Impact of pathogens, parasites, and predators on aphids. *Annual Review of Entomology* 13: 325-384.
- Heikinheimo, O. and M. Raatikainen. 1981. Grid refer-

- ences and names of localities in the recording of biological finds in Finland. *Notulae Entomologicae* 61: 133–154. [In Finnish].
- Kamijo, K. and H. Takada. 1973. Studies on aphid hyperparasites of Japan, II. Aphid hyperparasites of the Pteromalidae occurring in Japan (Hymenoptera). *Insecta Matsunurana*, n.s. 2: 39–76.
- Keller, L. J. and D. J. Sullivan, S. J. 1976. Oviposition behavior and host feeding of *Asaphes lucens* an aphid hyperparasitoid. *Journal of the New York Entomological Society* 84:206–211.
- Kurdjumov, N. V. 1913. Notes on Pteromalidae (Hymenoptera, Chalcidoidea). *Revue Russe d'Entomologie* 13: 1–24.
- Lal, K. B. 1934. Insect parasites of Psyllidae. *Parasitology* 26: 325–334.
- Le Ralec, A. 1995. Egg contents in relation to host-feeding in some parasitic Hymenoptera. *Entomophaga* 40: 87–93.
- Levine, L. and D. J. Sullivan, S.J. 1983. Intraspecific tertiary parasitoidism in *Asaphes lucens* (Hymenoptera: Pteromalidae), an aphid hyperparasitoid. *Canadian Entomologist* 115: 1653–1658.
- Lindroth, C. H., H. Andersson, H. Bödvarsson, and S. H. Richter. 1973. Surtsey, Iceland. The development of a new fauna, 1963–1970. Terrestrial Invertebrates. *Entomologica Scandinavica*, Suppl. 5: 1–280.
- Lundbeck, W. 1897(1896). Hymenoptera Groenlandica. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i Kjøbenhavn* 1896: 220–251.
- Mackauer, M. 1968. Aphidiidae. *Hymenopterorum Catalogus Pars* 3: 1–103.
- Mani, M. S. and G. G. Saraswat. 1974. Part III. Pages 85–107 in Mani, M. S., O. P. Dubey, B. K. Kaul, and G. G. Saraswat. Descriptions of some new and new records of some known Chalcidoidea (Hymenoptera) from India. *Memoirs of the School of Entomology, St. John's College*, no. 3. 377 pp.
- McMullen, R. D. 1966. New records of chalcidoid parasites and hyperparasites of *Psylla pyricola* Förster in British Columbia. *Canadian Entomologist* 98: 236–239.
- McMullen, R. D. 1971. *Psylla pyricola* Forster, pear psylla (Hemiptera: Psyllidae). Pages 33–38 in *Biological Control Programmes Against Insects and Weeds in Canada 1959–1968*. Commonwealth Institute of Biological Control Technical Communication 4. 266 pp.
- Nees ab Esenbeck, C. G. 1834. *Hymenopterorum Ichneumonibus affinium monographia, genera Europaea et species illustrantes*. Vol. 2. J. G. Cottae, Stuttgart and Tübingen. 448 pp.
- Peck, O. 1951. Pteromalidae. Pages 534–568 in Muesebeck, C. F. W., K. V. Krombein, and H. K. Townes (eds). *Hymenoptera of America North of Mexico—synoptic catalog*, United States Department of Agriculture Monograph No. 2. 1420 pp.
- Peck, O. 1963. A catalogue of the Nearctic Chalcidoidea. *Canadian Entomologist, Supplement* 30: 1–1092.
- Peck, O., Z. Bouček, and G. Hoffer. 1964. Keys to the Chalcidoidea of Czechoslovakia (Insecta: Hymenoptera). *Memoirs of the Entomological Society of Canada* 34. 120 pp.
- Philogene, B. J. R. and J. F. Chang. 1978. New records of parasitic chalcidoids of pear psylla (Homoptera: Psyllidae) in Ontario, with observations on the current world status of its parasitoids and predators. *Proceedings of the Entomological Society of Ontario* 109: 53–60.
- Provancher, L. 1887. *Additions et corrections a la Faune Hymenopterologique de la province de Québec*. C. Darveau, Québec. 477 pp.
- Ratzeburg, J. T. C. 1844. *Die Ichneumoniden der Forstinsecten in forstlicher und entomologischer Beziehung*, vol. 1. Berlin. 224 pp.
- Ratzeburg, J. T. C. 1848. *Die Ichneumoniden der Forstinsecten in forstlicher und entomologischer Beziehung*, vol. 2. Berlin. vi + 238 pp.
- Reinhard, H. 1857. Beiträge zur Geschichte und Synonymie der Pteromalinen. *Berliner entomologische Zeitschrift* 1: 70–80.
- Risbec, J. 1959. Pteromalidae de Madagascar (Hymenoptera: Chalcidoidea). *Mémoires de l'Institut Scientifique de Madagascar, série E* 11: 129–171.
- Rondani, C. 1848. Osservazioni sopra parecchie species di esapodi afidicidi e sui loro nemici. *Nuovi Annali delle Scienze Naturali e Rendiconto dei Lavori dell'Accademia delle Scienze dell'Istituto e della Società Agraria di Bologna* 9: 5–37.
- Schulz, W. A. 1906. *Spolia Hymenopterologica*. Paderborn. 355 pp.
- Sekhar, P. S. 1958. Studies on *Asaphes fletcheri* (Crawford), a hyperparasite of *Aphidius testaceipes* (Cresson) and *Praon aguti* (Smith), primary parasites of aphids. *Annals of the Entomological Society of America* 51: 1–7.
- Sharma, A. K. and B. R. Subba Rao. 1958. Description of two new parasites of an aphid from North India (Aphidiidae: Ichneumonidae and Pteromalidae: Chalcidoidea). *Indian Journal of Entomology* 20: 181–188.
- Sullivan, D. J. 1972. Comparative behavior and competition between two aphid hyperparasites: *Alloxysta victrix* and *Asaphes californicus* (Hymenoptera: Cynipidae; Pteromalidae). *Environmental Entomology* 1: 234–244.
- Walker, F. 1834. *Monographia Chalciditum*. *The Entomological Magazine* 2: 148–179.
- Walker, F. 1846. 1846. *List of the specimens of hymenopterous insects in the collection of the British Museum. Part I.—Chalcidites*. E. Newman, London. 100 pp.
- Waterston, J. 1929. On a chalcidoid bred from a flea larva. *Parasitology* 21: 103–106.
- Zetterstedt, J. W. 1838. *Sectio secunda. Hymenoptera*. Pages [417]–476 in Zetterstedt, J. W., 1838–1840, *Insecta lapponica descripta*. Lipsiae. 1139 pp.